MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

PUBLISHING and EDITORIAL OFFICES: 231, RUE ROYALE, BRUSSELS.

Yearly prepaid subscription { **Belgium . . . . . 70 Belgas** / **Other countries . . 75 Belgas** } including postage

Price of this single copy: 8 Belgas (not including postage).

(1 Belga = 5 Belgian francs.)

Subscriptions and orders for single copies (January 1931 and later editions) to be addressed to the General Secretary, International Railway Congress Association, 231, rue Royale, Brussels (Belgium).

Orders for copies previous to January 1931 should be addressed to Messrs. Weissenbruch & Co. Ltd., Printers, 49, rue du Poinçon, Brussels.

Advertisements: All communications should be addressed to the Association, **231, rue Royale, Brussels.**

CONTENTS OF THE NUMBER FOR AUGUST 1937.

CONTENTS.	Page.
I. **Note on train speeds**, by Lionel WIENER. — Part II. **Trains speeds and services in different countries** (*continued*). XX: **Germany** (*to be continued*)	1707
II. The « Slovak Arrow ». A new **fast railcar service** between Prague and Bratislava, by Paul KOLLER	1787
III. The **horse-power of locomotives.** Its **calculation and measurement**, by E. L. DIAMOND (Letter sent by the DEUTSCHE REICHSBAHN)	1796
IV. RECENT DEVELOPMENTS IN RAILWAY PRACTICE:	
New « Coronation » trains for the King's Cross-Edinburgh **high-speed service**, London and North Eastern Railway	1798
V. NEW BOOKS AND PUBLICATIONS:	
The **Universal Directory of Railway Officials and Railway Year Book**, 43rd Annual Edition, **1937/1938**	1810
VI. MONTHLY BIBLIOGRAPHY OF RAILWAYS	95

LIBRARY

OF THE

Permanent Commission of the International Railway Congress Association.

READING ROOM : **231, rue Royale, Brussels.**

Works in connection with railway matters, which are presented to the Permanent Commission, are mentioned in the « Bulletin ». They are filed and placed in the library. If the Executive Committee deems it advisable they are made the subject of a special notice. Books and publications placed in the reading room may be consulted by any person in possession of an introduction delivered by a member of the Association. Books, etc., may not be taken away except by special permission of the Executive Committee.

The Permanent Commission of the Association is not responsible for the opinions expressed in the articles published in the Bulletin.

All original articles and papers published in the BULLETIN are copyright, except with the consent of the Authors and the Committee.

Editions in French and in German are also published.

Vol. XIX. — No. 8. August 1937.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[656. 222.1]

Note on Train Speeds,

by LIONEL WIENER,
Professor at the University of Brussels.

PART II *(Continued)* [1]

Train speeds and services in different countries.

XX. — GERMANY.

SUMMARY.

CHAPTER LI. — GENERAL.

1. The railway system.
2. Railway companies.
3. Track- and loading gauges.
4. Train circulation.

CHAPTER LII. — MOUNTAIN LINES.

1. Hilly districts.
2. Lines with heavy gradients.
3. Rack railways.
4. Telpher lines.

CHAPTER LIII. — THE FERRYBOATS.

1. River services.
2. Lake services.
3. Maritime services.

CHAPTER LIV. — THE TRAINS.

1. Classes of trains :
   (*a*) the *FD* trains;
   (*b*) the *FDt* trains;
   (*c*) the *L* trains;
   (*d*) the *D* trains;
   (*e*) the *E* trains;
   (*f*) the *P* trains.
2. Light trains.
3. Goods trains.

CHAPTER LV. — THE SERVICES.

1. High-speed lines.
2. The important services.
3. Internal services.
   A) Trains radiating from Berlin.
   B) Secondary centres.
   C) Interprovincial services.
4. Services to watering places.
5. International services.
6. Urban and suburban services.

CHAPTER LVI. — SLEEPING-CAR AND RESTAURANT-CAR SERVICES.

1. Characteristics.
2. The *Mitropa*'s services.
3. The *International Sleeping-Car Company*'s German services.

(1) Cf. *Bulletin of the Railway Congress*, October and November 1933; January, May June and July 1934; February, March, April, May, July and October 1935; March, May, June, July and August 1936; February 1937.

CHAPTER LVII. — THE SPEEDS.

1. Development.
2. Distribution of methods of traction :
   (*a*) Propeller-driven vehicle;
   (*b*) Fast diesels;
   (*c*) Electric traction;
   (*d*) Electric motor coaches;
   (*e*) Steam locomotive traction.
3. Fast steam services :
   (*a*) Berlin-Hamburg line;
   (*b*) Berlin-Dresden line.
4. The fastest runs.
5. Long non-stop runs.
6. Conclusions.

CHAPTER LVIII. — APPENDICES.

1. Navigation on the lakes.
2. River navigation.
3. The *Reichsbahn*'s bus services.

CHAPTER LI.

General.

LI-1. — **The railway system.** — The first German railway, from Nuremberg to Furth *(Ludwigsbahn)*, two shares of which were bought by the Bavarian Government in 1833 (1), was opened to operation on the 7th December, 1835, soon after the *Dublin & Kingstown Ry.* (2) (Ireland), opened on the 17th December 1834, and the Brussels-Malines Ry., opened on the 5th May 1835 (3).

On the 21st October 1843, the German and Belgian frontier sections were opened simultaneously, thus connecting Cologne and Liége.

On the other hand, owing to the great number of lines built subsequently by the Companies, operation had become particularly complicated when, on the 10th November, 1846, the *Union of Prussian Railways* (now, and since the admission of foreign countries, known as the « Verein » of Central European Railways) was founded.

Standards applicable to all the main lines were adopted on the 12th June, 1878.

Central European (M.E.Z.) time was introduced on the 1st April, 1893, and the 24-hour notation on the 1st May, 1927.

LI-2. — **The Companies.** — On the 1st December, 1838, the first State railway, the Brunswick-Wolfenbüttel line, was opened to traffic. Since then the State systems have principally developed and most of the important private railways have been systematically bought up since 1871. On the 1st July, 1925, the Government bought the 48 km. (30 miles) long German section of the *Noord Braband* Company from Wesel to the German frontier, while the Dutch Government took over the rest of the railway in Dutch territory (see pp. 282/370 et seq.). The result is that there are only two important private standard-gauge railways, the *Lübeck-Büchen* and the *Eutin-Lübeck* (fig. 366).

The eight important still autonomous main-line Administrations were taken over by the State on the 31st March, 1920, the *Reichsbahn* was created on the 12th February 1924 and the operation handed

(1) The line was closed in 1922 owing to lack of traffic, but it was reopened on the 10th September, 1927. The *Stockton & Darlington Ry.* was inaugurated on the 27th September, 1825; the *Liverpool & Manchester Ry.* on the 15th September, 1830, and the *Canterbury & Whitsable Ry.* on the 3rd May, 1830.

(2) Built as standard gauge and converted to the Irish 1.60-m. (5' 3") gauge in 1857.

(3) The first Canadian railway, the *Champlain & St. Lawrence Ry.*, was opened to traffic from Laprairie to St. John's on the 21st July, 1836.

Fig. 366. — Railway Companies in the Hamburg-Lübeck region.

over to the *Deutsche Reichsbahn Gesellschaft* on the 11th October 1924. The *Deutsche Reichsbahn Gesellschaft* operated 53 883 km. (33 482 miles) of standard gauge line and 903 km. (561 miles) of narrow gauge. As is known, this organisation has now been done away with, and the railway system is operated by the State itself.

The Lübeck-Büchen Ry. Co. operates 190 km. (118.1 miles) of lines divided up as follows (fig. 366) :

Lübeck-Büchen;
Lübeck-Hamburg;
Lübeck-Travemünde-Niendorf;
Lübeck-Schlutup;
Wandsbek-Hamburg-Rothenburgsort;
Lübeck-Segelberg (secondary line 29 km. = 18 miles long, and worked on lease.

Table 302.

NOTEWORTHY RUNS OVER THE LUBECK-BÜCHEN CO.'S LINES and other lines worked by this Company. (Non-stop runs are shown in **heavy** type).

Runs.	Distance. Km.	Distance. Miles.	Time of departure.	Time spent.	Number of stops.	Speed. Km./h.	Speed. M.p.h.	Train.
ıburg-Lübeck-Travemünde-								
iendorf-Ostsee	87	54.1	10.34 a. m.	1.36	2	54.4	33.8	D. 113/81.
amburg-Lübeck.	63	39.1	**Do.**	**0.51**	...	**74.1**	**46.0**	D. 113.
Do.	Do.	Do.	1.11 p. m.	0.40	...	94.5	58.7	605 H-L Schnellzug
amburg-Travemünde . . .	83	51.6	**6.35** a. m.	**1.27**	...	**57.3**	**35.6**	S. 41.
Do.	Do.	Do.	1.11 p. m.	1.00	1	83.0	51.8	605 H-L Schnellzug
ibeck-Travemünde. . . .	20	12.4	**1.53** p. m.	**0.18**	...	**66.7**	**41.4**	Do.
-Lübeck-Berlin Lehrte . .	378	234 9	6.08 a. m.	4.53	9	77.4	48.1	D. 51.
ıtin-Lübeck	33	20.5	**7 00** a. m.	**0.29**	...	**68.2**	**42.4**	Do.
ibeck-Ratzenburg	22	13.7	**7.35** a. m	**0.18**	...	**73.3**	**45.5**	D. 61.

The *Eutin-Lübeck Company* operates 33 km. (20.5 miles) of main line; in addition to the 24-km. (14.9 miles) branch to Neustadt.

Thanks to their geographical situation, these companies share in a certain number of important *D-Züge* services (fig. 367), in particular those linking up Hamburg with Kiel, Rostock, Sassnitz and Warnemünde (with which we will

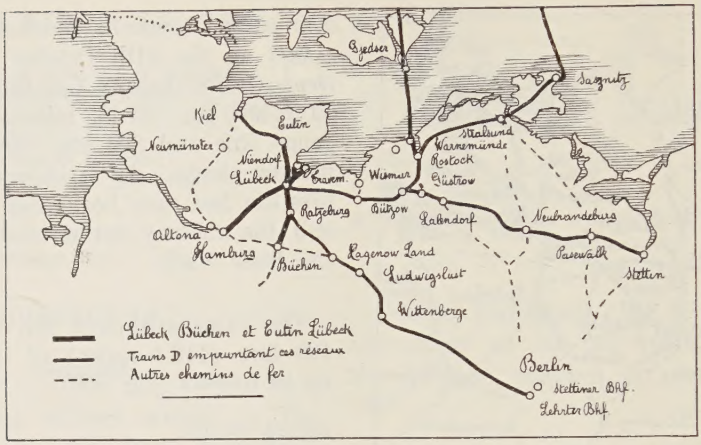


Fig. 367. — *D-Züge* services running over the *Lübeck* Companies' lines.

deal again in connection with the ferry-boat services) and those from Berlin to Kiel. The distance from Berlin by this route and the *Eutin-Lübeck Co.*'s line is 347 km. (215.6 miles), whereas via Hamburg and the *Reichsbahn* line it is 400 km. (248.6 miles).

For its fast local services the Company uses two very interesting streamlined self-contained units consisting of a 4-8-2-T *Henschel* tank engine (fig. 368) and two double-decker coaches, built by the *Linke-Hofmann Werke A. G.*, of Breslau (fig. 369).

The 120-H.P. engine has a maximum speed of 120 km. (75 miles) an hour. The two rakes, put into service on the 7th April, 1936, have 300 seats, 258 third class and 42 second.

If the Lübeck-Büchen Ry. was the first

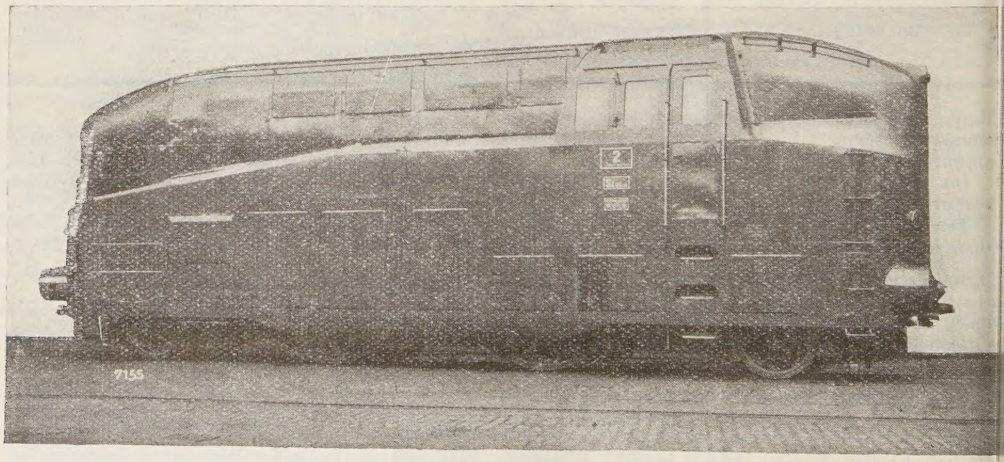


Fig. 368. — 4-8-4 T streamlined locomotive of the *Lübeck-Büchen Railway.* Built by *Henschel und Sohn.*

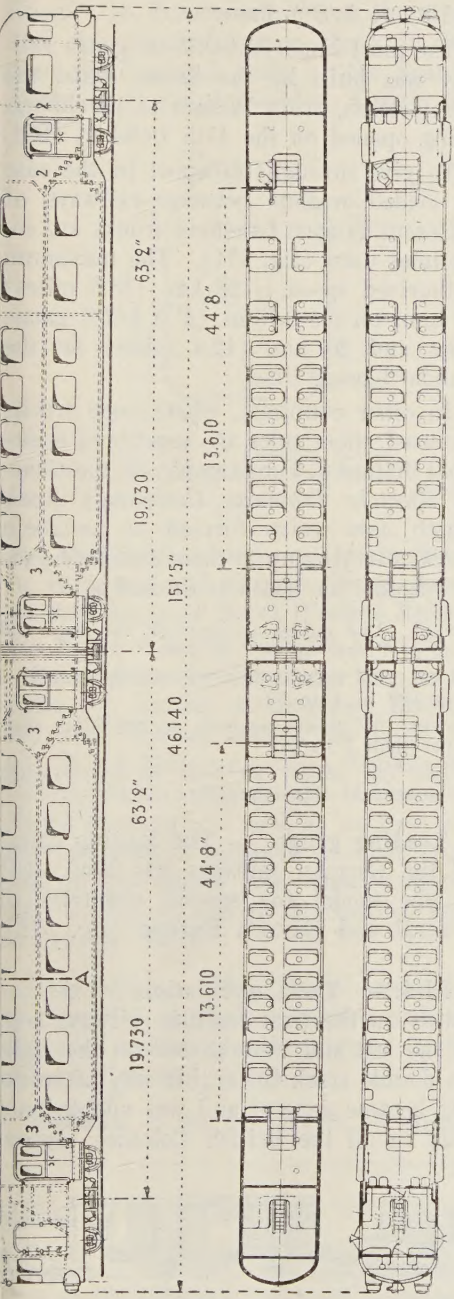


Fig. 369. — Double-deck coaches of the *Lübeck-Büchen Railway.*

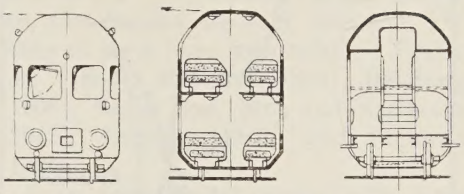


Fig. 369*b*. — Cross sections and end view of double-decker coaches of the *Lübeck-Büchen* Railway.

to put a *streamlined* rake of double decker vehicles into service, it was far from being the first company to use stock of this type (not streamlined).

LI-3. — **Track gauges.** — Although the first German railways were built to standard gauge, and the Kingdom of Bavaria passed on the 18th February, 1836, a law decreeing that the 1.435-m. (4′ 8 1/2″) gauge was to be used for all the railways to be built, the Grand Duchy of Baden adopted the Irish gauge of 1.60 m. (5′ 3″) for its railways, and even drew up a general programme with connections with the Belgian, Swiss and other lines, in competition with the standard gauge railway on the left bank of the Rhine.

In 1840, it opened to operation the 22 km. (13.7 miles) long section from Mannheim to Heidelberg, which was extended in 1843 as far as Karlsruhe and soon afterwards to the Swiss frontier, where it connected with the *North of Zurich Ry.* also built to wide gauge.

The German broad gauge (1.60 m. = 5′ 3″) system thus included 337 km. (209.1 miles) of lines (fig. 370) :

Single track :		
Mannheim-Heidelberg .	22 km.	(13.7 miles).
Freiburg-Haltingen . .	48 km.	(29.8 miles).
Oos-Baden	5 km.	(3.1 miles).
Double track :		
Heidelberg-Freiburg . .	227 km.	(141.0 miles).
Appenweier-Kehl . . .	15 km.	(9.3 miles).

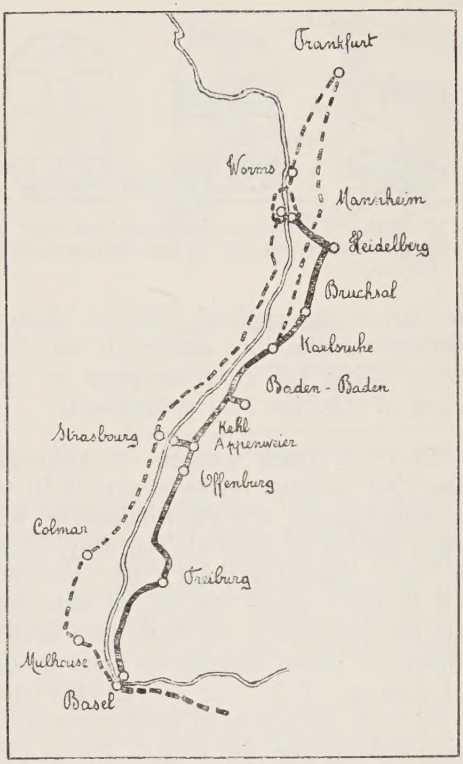


Fig. 370. — Former broad-gauge system of the *Baden State Railway*.

As the *German Verein* adopted the standard gauge, it was decided to convert the Baden lines to this gauge. The work was begun in May, 1854, and completed on the 15th April, 1855, whilst the *North of Zurich Ry.* was also converted to standard gauge when it was amalgamated with the *Swiss Eastern Ry.*

Though most of the secondary lines were built to 1.435-m. (4′ 8 1/2″) gauge, there are a certain number of metre, 0.75 m., and 0.60 m. (3′ 3 3/8″, 2′ 5 1/2″ and 1′ 11 5/8″) lines.

The most important 0.75-m. gauge railway was built by the *Saxon State*, the first section, from Wilkau to Kirchberg, being opened on the 17th October, 1881.

To give through transport in the case of loaded wagons between railways of different gauges, *Langbein* trucks are sometimes used (fig. 371). The maximum authorised speed is 25 km. (15.5 miles) an hour on the 0.75-m. (2′ 5 1/2″) gauge lines and 20 km. (12.4 miles) on the standard-gauge lines.

In other countries, where such trucks are used, these rules are sometimes somewhat different. For example, on the *Geneva Electric Tramway Company*'s lines, which uses trains formed of Langbein trucks carrying up to three standard gauge wagons, the speed is limited to :

20 km. (12.4 miles) an hour on the level and on gradients up to 1 in 100;

15 km. (9.3 miles) an hour on gradients of 1 in 100 to 1 in 33;

10 km. (6.2 miles) an hour on gradients steeper than 1 in 33;

6 km. (3.7 miles) an hour on small-radius curves and through points.

Loading gauge. — The loading gauge of the German railways has been used as the model for several countries of Central and Eastern Europe (fig. 372).

LI-4. — **Train circulation.** — As the trains on the first English railways kept to the left and were passed on the right on double track lines, this way of working became general and was adopted not only in all the British Colonies (except

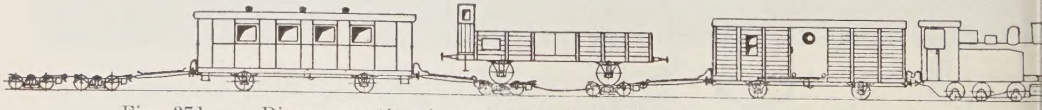


Fig. 371. — Diagrammatic view of train including *Langbein* transporter trucks.

Canada), but also on the European Continent : in France (except on the *Metro* and the *Alsace-Lorraine Rys.*) in Belgium, Switzerland, Italy, on the Spanish *Norte*, in Portugal, Sweden, Austria and

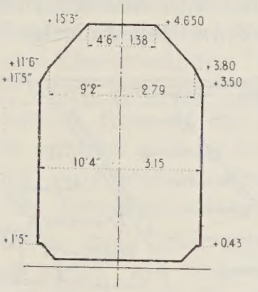


Fig. 372. — Loading gauge of Central European Railways.

the new States (except on certain lines), in Hungary, and also in China, Japan, on the *Chicago & North Western Railway* (U. S. A.), and also in South America.

Everywhere else the trains keep to the right (1), namely in Germany, Holland, Denmark, Norway, Russia, the Baltic States, all the Balkan countries, Canada, the United States (except the *Chicago & North Western)* (2) and, as we have just said, on certain railways in other countries : the *Metro and Alsace-Lorraine Rys.* in France, and all the Spanish Rys., except the *Norte*.

Timetables. — The figures used relate to the 1936 summer timetables and the distances quoted are those given in the official German guide-book.

Stations. — As the rule is for special lines to be reserved for special purposes, the stations are very extensive, and many of them have been rebuilt : Frankfort (1882), Mayence (1884), Hamburg (1906), Basle, Bad. Bhf. and Karlsruhe (1913), Leipzig (1915) and Stuttgart (1922).

Apart from coastal towns, in the large inland towns there are only a dozen terminal stations left : four in Berlin, and one in each of the following towns : Altona, Oberhausen, Leipzig, Kassel, Frankfort, Wiesbaden, Ludwigshafen, Stuttgart, Kempten and Munich, as well as a supplementary terminus in Breslau.

To these must be added Kiel, Lindau, and Friedrichshafen, all of which, in addition to the ordinary town station, have a maritime (or lake) station, as well as a dozen reverses used as termini (1). The number is therefore considerable, even in comparison with neighbouring countries (2).

Cross-town lines. — The main-line

(1) For this information we are obliged to Mr. Willox.

(2) Formerly the *New York Central* trains also kept to the right. The change-over took place in 1909/1910.

(1) *Terminus.*	*Line on which situated :*
Grossalmerode Ost.	Kassel-Eichenberg.
Fürstenhagen	(Kassel) Schwebda-Heiligenstadt.
Schillingsfürst . . .	Dombühl-Rothenburg (Bavaria).
Bad Dürkheim . . .	Neustadt-Monsheim.
Bad Kissingen . . .	Ebenhausen-Gmünden.
Lauscha	Oberlauscha-Probstzella.
Rennsteig (Thür.) .	(Erfurt) Themar-Plaue (Thür.).
Wurzbach (Thür.) .	Saalfeld-Lobenstein.
Isny	Leutkirch-Kempten.

(2) Here are a few examples :

5 in Belgium : Brussels (2) — Antwerp (2) — Liége (Longdoz).

5 in Holland : The Hague — Amsterdam (2) —Rotterdam (2).

14 in France : Paris (7) — Lille — Rouen — Orleans — Tours — Bordeaux — Lyons — Marseilles.

2 in Switzerland : Lucerne — Zurich. Reverses — termini at Meiringen and Le Locle.

5 in Italy : Rome — Florence — Milan — Naples (2).

railways run right through certain important towns. In addition to the through trains, these lines are then used by most of the trains from these towns which, in each direction, start some distance beyond the town. In this way they pick up traffic from a certain number of the town stations they serve. This is the case at Berlin, Hamburg, and Cologne.

BERLIN is obviously the most complete example of this method of operation (fig. 373) : the main line from east to west, the *Stadtbahn* opened on the 7th Februa-

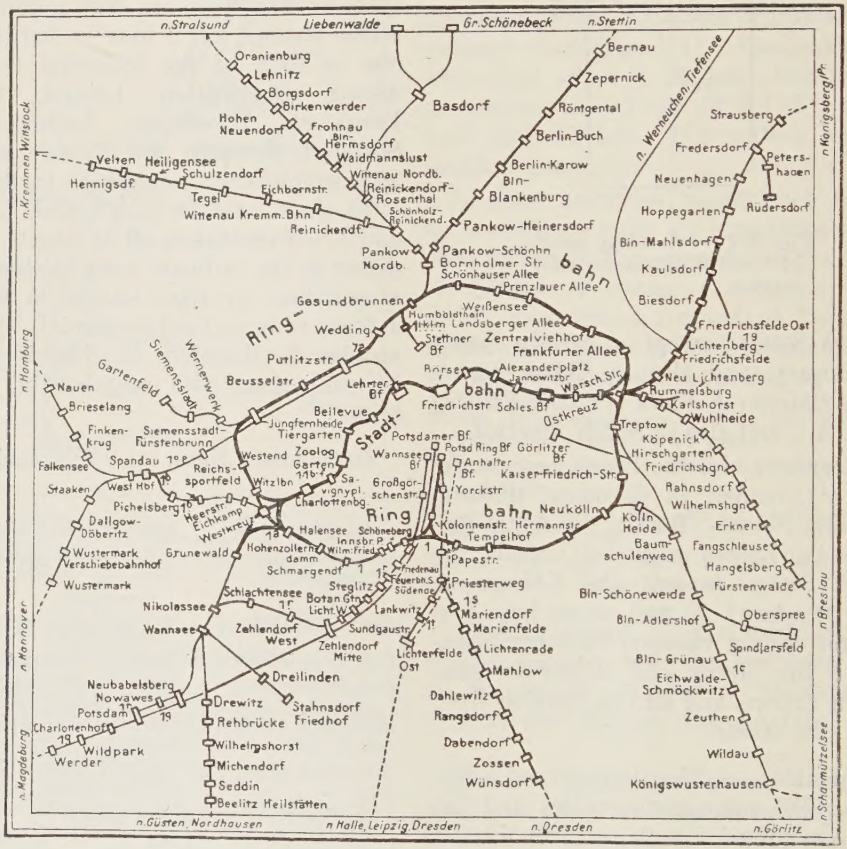


Fig. 373. — Diagrammatic map of the Berlin urban and suburban Railways (Stadt-, Ring-, and Vorort-Bahnen).

ry 1882 between Charlottenburg and the Silesia station; a north to south Metropolitan line now under construction; a circular line, the *Ringbahn*, and lines radiating from the following termini : Gorlitz to the south-east, Anhalt and Potsdam to the south-west; Lehrte to the north-west and Stettin to the north-east.

The central east to west line is run over, not only by the *Stadtbahn* electric

trains (1) adjacent to the main line, but also by all the important trains serving the east or west of Germany. Those to the west start from the Schlesischer Bhf., and serve Alexanderplatz (2.2 km. = 1.4 miles), Friedrichsstrasse (4 km. = 2.5 miles), Zoologischer Garten (9 km. = 5.6 miles) and Charlottenburg (11.3 km. = 7 miles), which adds about 40 minutes to the journey times of the *D* trains and 24 to 26 minutes to those of the *FD* trains, which only stop at Friedrichsstrasse and the Zoologische Garten.

The north to south line, now under construction, which will only be used by the electric trains, will likewise link up the southern termini of Anhalt (and Potsdam) and the northern terminus of Stettin, crossing the first line at Friedrichsstrasse.

The position at Hamburg is similar. Before running into the main station (6.5 km. = 4.0 miles), trains from Altona Hbf. have stopped at Hamburg Dammtor (5 km. = 3.1 miles), which adds 12 minutes to the journey time of *FD* trains and 14 to 15 to that of the *D* trains, to which must be added the stopping time at Hamburg Hbf.

At Cologne, before leaving the main station (Hbf.) trains from Cologne-Deutz 200 m. (0.75 mile) away, have left this station 10 to 12 minutes earlier.

The position in Brussels will be the same as in Berlin when the Nord-Midi junction is completed, with the sole difference that the distance between the Nord, Central and Midi stations is only 2.5 km. (1.55 miles).

Apart from the main-line trains, Berlin is served by the *S*- and *U-Bahnen* and Hamburg by the *Stadt- und Vorort Bahn*, which we will deal with in connection with urban services.

(1) The first section to be electrified was from Potsdam to Erkner, opened on the 11th June, 1928.

CHAPTER LII.

Mountain lines.

LII-1. — **Hilly districts.** — Though there are no high mountains except along the southern frontier : Black Forest, Swabian Alps, and in particular the Bavarian Alps, there are some fairly important mountain ranges in other parts of the country : from Treves to Hof, south of the Moselle, north of the Main, as well as at the sources of the upper tributaries of the Weser (Hunsrück, Taunus, Thüringer Wald); the Harz mountain mass between the Elbe and the Weser, and finally the smaller mountain ranges forming the boundaries of former Bohemia to the west, north and north-east (Boehmerwald, Erzgebirge and Swiss Saxony, Riesengebirge and its accessory ranges).

Consequently there are few tunnels. The longest of them, with double track, is that of Cochem on the Moselle line, which was opened on the 15th March 1879 and is 4 203 m. (2.61 miles) long; the Elm tunnel, between Frankfort and Bebra (built in 1909), is 3 500 m. (2.17 miles) long and the Krähberg tunnel on the Odenwald line 3 100 m. (1.93 miles) long. All the others are less than 2 km. (1.24 miles) long (1). Though there are not many tunnels, the mountainous nature of certain parts of the country has had a great influence on many of the

(1) On the line from Cologne to the Belgian frontier, the Koenigsdorf tunnel, built in 1837 this side of Aix-La-Chapelle is 1 500 m. (0.93 mile) long, and the Welkenraedt tunnel, built in 1871, is 740 m. (0.46 mile) long.

railway lines, the maximum altitude being reached at Oberwiesenthal (892 m. = 3 935′ above sea level) on the 20th July 1897, and since then at Bärental (1 030 m. = 3 379′ above sea level).

The railways in southern Germany run through the mountainous regions of Bavaria, Wurtemberg and Baden, so that many steep gradients are encountered; the gradient is as much as 1 in 50 when crossing the Thüringerwald between Schweinfurt and Erfurt; 1 in 45 on the Geislingen gradient, in Wurtemberg; 1 in 40 between Hochstadt and Probstzella on the Berlin-Munich main line, as well as at Neuenmarkt, and 1 in 25 in the region between Bad Reichenhall and Berchtesgaden. Owing to the development of this watering place, it is now served by main-line trains and even by through electric motor coaches from Stuttgart.

Apart from these lines, there are local railways which also serve mountainous regions. Although the train speeds are of necessity moderate, important through trains run over these lines, in whose case the traction problem is of prime importance. For example, between Waldshut and Immendingen which are only 10.2 km. (6.3 miles) apart as the crow flies, the railway has to run 25.6 km. (15.9 miles) in order to make good the 231 m. (758′) difference in altitude.

The Black Forest Railway, built between 1866 and 1873, across the bend of the Rhine (1), in spite of its 1 in 50 gradients is only able to cross the central range by means of a double spiral and a helical tunnel between Hornberg and Nussbach, by which it climbs from 180 to 210 m. (580′ to 689′) above sea level.

The *Murgtalbahn*, its branch from Hausach towards Freudenstadt (at 756 m. = 2 480′ above sea level), has 1 in 20 gradients. The 0-10-0-T locomotives haul 3 or 4 four-wheeled vehicles on this line.

An endeavour was therefore made to improve the services in mountainous parts, by designing appropriate locomotives for fast trains over fairly hilly lines, and express train locomotives for lines with steep gradients.

A 4-8-4 type of locomotive was consequently designed, for a speed of 140 km. (87 miles) an hour, and the dead weight of the rolling stock reduced. This reduction reached 25 % in the case of the corridor coaches, 15 % for the Eilzüge rolling stock, and 25 % for the local-train coaches.

LII-2. — **Lines with heavy gradients** (fig. 374). — Powerful 2-10-2 tank locomotives were used, which made it possible to improve the operation considerably. To reach Altenberg, for example, the trains from Dresden ran for 11 km. (6.8 miles) over the standard-gauge line to Heidenau whence a 0.75-m. (2′ 5 1/2″) gauge line, 42 km. (26.1 miles) long, continued to destination. In order to avoid too costly works, it was decided to retain the unfavourable technical conditions of this line, the gradients being 1 in 30 and even 1 in 26 and the radius of curves as little as 140 m. (7 chains), but to convert the existing gauge to standard so that the whole journey could be worked with the same locomotives from Dresden to Altenberg. To do this, the locomotives had to reach a high speed on the Dresden-Heidenau section; this speed was fixed at 70 km. (43.5 miles), and for the res

(1) Offenburg and Singen are 163 km. (101.3 miles) apart, but the railway line between them along the Rhine via Basle is 237 km. (147.3 miles) long.

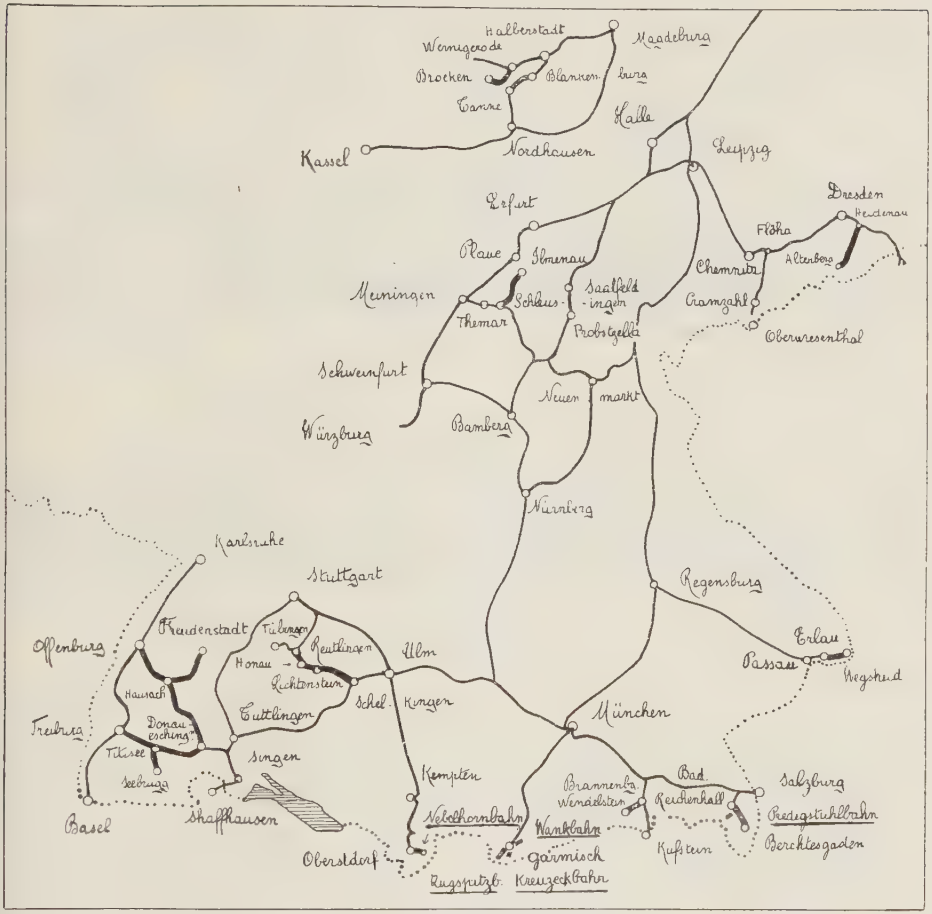


Fig. 374. — Location of noteworthy railway sections in the mountainous districts of Central and Southern Germany.

of the line at 40 km. (25 miles) with a train of 6 light coaches, weighing 180 t. (177.2 Engl. tons).

These locomotives, the axle load of which cannot exceed 18.5 t. (18.2 Engl. tons), can run through curves of 100 m. (5 chains) radius. This flexibility is obtained on two of them by the use of *Schwartzkopff-Eckhardt* bissels and on two others by *Luttermöller* axles [1]

(1) The leading features and dimensions are as follows :

Pressure.	20 kgr./cm. (284 lb./sq. in.).	Water capacity	14 m³. (3 080 Br. gall.).
Weight in running order.	124.9 t. (122.9 Engl. tons).	Fuel capacity.	3 tons.
Adhesive weight	90.9 t. (89.5 Engl. tons).	Rigid wheel base. . . .	5.20 m. (17' 1").
Tare weight	100.6 t. (99.0 Engl. tons).	Rigid wheel base — Percentage of total wheel base	44.5 %.

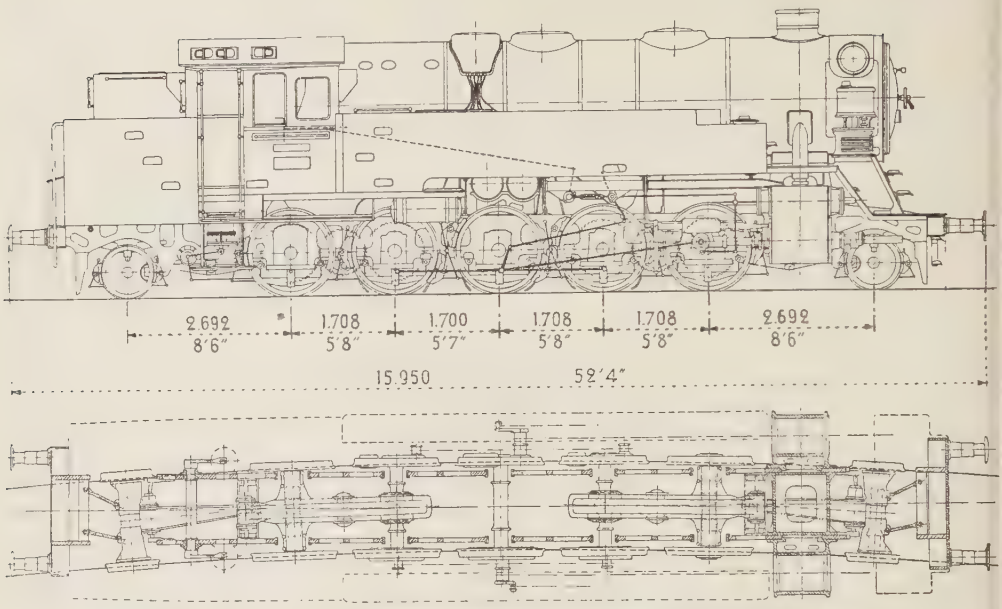


Fig. 375. — 2-10-2-T Class 84 locomotives with *Luttermöller* axles.

(fig. 375). The *Linke-Hofmann* third-class metal carriages only weigh 25 t. for 70 seats, i. e. 350 kgr. (772 lb.) per seat.

In the last column of Table 304-*b* mention is made of a 2-10-2-T *Borsig* locomotive derived from the same type, formerly built for the *Halberstadt-Blankenburg Ry.*, but of increased power.

The BROCKEN RAILWAY, like the *Halberstadt-Blankenburg Ry.* situated in the Harz, also has steep gradients as can be judged by the successive altitudes reached :

Wernigerode	0 km.		+ 234 m. (768')
Steinerne-Renne	6.3 km.	(3.9 miles)	+ 314 m. (1 030')
Drei Annen-Hohne. . . .	14.5 km.	(9.0 miles)	+ 540 m. (1 772')
Schierke	19.9 km.	(12.4 miles)	+ 685 m. (2 247')
Götheweg	28.1 km.	(17.5 miles)	+ 956 m. (3 137')
Brocken.	33.4 km.	(20.8 miles)	+ 1 142 m. (3 747')

In both directions, the run takes about an hour and a half.

LII-3. — **Rack railways.** — Germany was one of the first countries to make use of the rack on main lines, even on standard-gauge lines. A few words must therefore be said on this subject, particularly about the ratio between the useful weight, the gross weight and the train speed, on the usual gradients of 1 in 20 to 1 in 16.

(a) The BADEN HÖLLENTAL RY. links up the Rhine (Freiburg in Brisgau) and the Danube (Donaueschingen), through the south of the Black Forest (and Titisee). A Klose rack was formerly used

on a 7 200-m. (4.47 miles) section (1) to reach a culminating point 893 m. (2 930′) above sea level, i. e. 624 m. (2 047) above the starting point, but *since the electrification of the line the rack has been abandoned.*

Table 303.

TRAINS OF THE HÖLLENTAL RAILWAY.

Run.	Distance.	Time of departure.	Time spent.	Speed. Km./h.	Speed. M.p.h.	Number of intermediate stops	Train.
burg-Wiehre (48 km. = 29.8 miles)-Hinterrten	22.9 km. (14.2 miles)	9.04 a. m.	0.38	36.2	22.5	—	E train.
		R 3.10 p. m.	0.32	42.9	26.6	—	Do. (return).
o.		7.21 a. m.	0.54	25.4	15.8	7	Ordinary train.

The altitude of the stations served is as follows :

Freiburg	0 km.	—	+ 269 m.	(882′)
Kirchzarten	12.5 km.	(7.8 miles)	+ 392 m.	(958′)
Hirschsprung . . .	19.7 km.	(12.2 miles)	+ 559 m.	(1 834′)
Culminating point. .			893 m.	(2 930′)
Hinterzarten. . . .	26.9 km.	(16.7 miles)	+ 885 m.	(2 904′)
Titisee	30.8 km.	(19.1 miles)		
Neustadt	36.4 km.	(22.6 miles)	+ 805 m.	(2 641′)
Donaueschingen. . .	76.3 km.	(47.4 miles)		

The *P* trains are formed of light four-wheeled vehicles weighing not more than 100 t. (98.4 Engl. tons) altogether.

The 19-km. (11.8 miles) long branch from Titisee to Seebrugg, the Dreiseenbahn, opened in 1926, runs towards the Feldberg, 1 500 m. (4 920′) above sea level. At Bärental (7.6 km. = 4.7 miles) it reaches an altitude of 1 030 m. (3 379′), the highest point attained by a standard-gauge railway in Germany.

(*b*) The Ilmenau-Schleusingen (Thüringerwald) Ry. — After considering an ordinary adhesion line (2), in 1904 it was decided to build a mixed line : 30 km. (18.6 miles) of standard-gauge adhesion railway and five sections, 6 240 m. (3.87 miles) long altogether of Abt rack railway, with maximum gradients of 1 in 40 and 1 in 17 respectively, and curves of 250 and 200 m. (12.5 and 10 chains) radius.

The 1904 0-6-2-T locomotives, with two gear wheels, weighing 59 tons in working order, hauled :

165 t. up 1 in 20 gradients at a speed of 10 km. (6.2 miles) an hour;

135 t. up 1 in 17 gradients at a speed of 10 km. (6.2 miles) an hour;

105 t. up 1 in 17 gradients at a speed of 15 km. (9.3 miles) an hour.

(1) On the adhesion section, the maximum gradients are 1 in 40, the minimum radius of curves 300 m. (15 chains); on the rack section, these figures reached 1 in 18 and 260 m. (13 chains) radius.

Two 2-6-2 tank locomotives haul 6 bogie vehicles weighing 175 t. (172.2 Engl. tons) except on the rack section where a 0-6-2 tank locomotive is used in addition.

(2) With curves of 200 m. (10 chains) radius and gradients of 1 in 33, the line would have been 2.4 km. (1.5 miles) longer.

The line runs up and down the two sides of a hill. Starting at 477 m. (1 565') above sea level, it climbs to 747 m. (2 451') and then runs down to 370 m. (1 214'). There is no reverse slope on neither side.

(*c*) The PRUSSIAN HARZ RY., 30.5 km. (18.95 miles) long, opened in 1885, links up Blankenburg and Tanne by running across two mountain ranges. There are 10 Abt rack sections, 285 to 1 550 m. (0.177 to 0.96 mile) long, with a maximum gradient of 1 in 17 and curves of 300 m. (15 chains) radius and 200 m. (10 chains) on the less steep gradients. On the adhesion sections, the gradients are limited to 1 in 40 and the radius of curves to 200 m. (10 chains). The following altitudes are reached :

Halberstadt	0 km.		
Blankenburg	18.8 km.	(11.7 miles)	+ 106 m. (348')
Hüttenrode	28.7 km.	(17.8 miles)	+ 477 m. (1 565')
Rübeland	33.2 km.	(20.6 miles)	+ 384 m. (1 260')
Culminating point	40.2 km.	(25.0 miles)	+ 503 m. (1 650')
Rotenhütte	43 km.	(26.7 miles)	+ 431 m. (1 414')
Tanne	49 km.	(30.4 miles)	+ 460 m. (1 509')

The Abt 0-6-2-T 50-ton locomotives hauled 120 t. (118.1 Engl. tons) at 12 km. (7.5 miles) an hour on the rack section and 25 km. (15.5 miles) an hour on the adhesion sections.

The 2-8-2 tank locomotives by which they were replaced in 1922 weigh 94 t. (92.5 Engl. tons), 81 t. (79.7 Engl. tons) being available for adhesion. They haul 150 t. (147.6 Engl. tons) on the rack sections.

Recently the mixed locomotives were replaced by new 2-10-2 *Borsig* locomotives with simple adhesion (fig. 376)

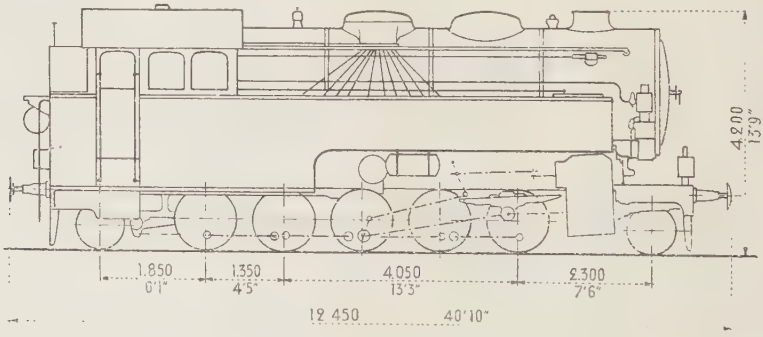


Fig. 376. — 2-10-2 adhesion tank locomotive, built by the *Borsig* Works, Tegel-Berlin.

which can run through curves of 140 m. (7 chains) radius. This represents a notable progress, as the rack system implies many subjections it is very interesting to avoid. For instance, on the *North Western Ry.* (India), maximum gradients of 1 in 25 were equipped on the rack system, and it was found possible to do away with it, thanks to the use of more powerful locomotives. The introduction of *Borsig* tank engines on the *Harz Railway* has still further increased

ie gradients which can be worked by mple-adhesion locomotives.

(d) The Bavarian Wegscheid Line. — etween Erlau (near Passau) and Wegcheid there is 1 610 m. (1 mile) of ack railway divided up into two sections (1).

On the Reutlingen-Schelklingen line, etween Honau and Lichtenstein there is rack section 1 990 m. (1.24 miles) long. The speed of the trains is 12 km. (7.5 iles) an hour both up and down the ne on the former, and 10 km. (6.2 mies) an hour on the latter line.

We will not deal herein with rack railays used for tourist traffic only (1).

Locomotives. — The question of mo-ve power on these lines is of prime imortance, as on its solution depends the iture of this kind of traction. Though iese are important lines, and not merely ourist services, very little progress was ade in this connection for many years, nd in many cases the original locomotis are still in use.

Two German builders, the *Esslingen* Works, and the *Borsig* Works, of Tegel-Berlin, have however specialised in building locomotives of this type, and have designed some interesting examples for foreign countries. The 1922 mixed 2-8-2-T Borsig locomotives showed considerable progress over their predecessors. They hauled 150-ton trains up 1 in 17 gradients and could run through curves of 140 m. (7 chains) radius. To make this possible the flanges of the driving wheels were thinned down and the trailing pair of wheels given some play.

In spite of this the rack section was still a drawback from the operating point of view. Messrs. *Borsig* then designed, for the *Halberstadt-Blankenburg Railway,* a 2-10-2-T locomotive (fig. 376) developed from the previous design, which could not only cover the working on the level, but also with simple adhesion haul the train over the mountain sections up 1 in 17 gradients. This time, to run through the same curves, the flanges of the driving wheels had to be cut away altogether, and play given to the second and fifth pairs of wheels. The end coupled wheels with the carrying pairs of wheels formed Krauss bogies. The maximum axle load could not exceed 15 t. (14.8 Engl. tons) and these locomotives had to haul 200-t. (196.8 Engl. tons) trains up the gradients at a speed of 12 to 15 km. (7.5 to 9.3 miles) an hour. During the trials, they hauled 260 t. (256 Engl. tons) at 12.25 km. (7.61 miles) an hour.

The leading dimensions of another 2-10-2-T *Borsig* locomotive built on the same principles for other mountain lines where the gradients were not quite so steep are also given (*see table 304-b*).

LII-4. — **The German telpher lines** for

(1) The oldest is that from Stuttgart to egerlock, opened on the 23rd April, 1884. was succeeded by the following :

The *Siebengebirgsbahn*, from Königswinter 0 m. = 164' above sea level) to Petersrg (334 m. = 1 096'); length 1 500 m. 0.932 mile); maximum gradient 1 in 4.

The *Drachenfels Ry.* (325 m. = 1 066' ove sea level); length 1 520 m. (0.944 ile); gradient 1 in 3.9;

The *Wuppertal-Tölleturm line;* difference altitude 170 m. (588'); length 1 630 m. .01 miles);

The *St. Andreasbergbahn* (Harz), from the ation (434 m. = 1 424' above sea level) to e town (604 m. = 1 982'); length 1 700 m. 056 miles);

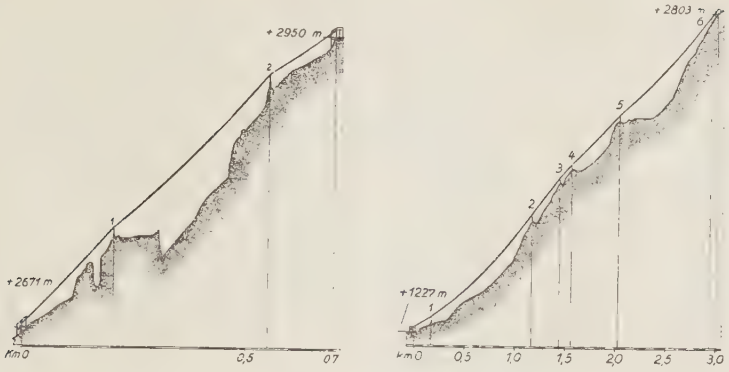
The *Wendelsteinbahn*, from 10 km. (6.2 mi-) beyond Brannenburg (Munich-Kufstein e) to Wendelstein, which climbs from 472 1 790 m. (from 1 548' to 5 873') above sea el, also has a rack section.

TABLE 304 (*a*).

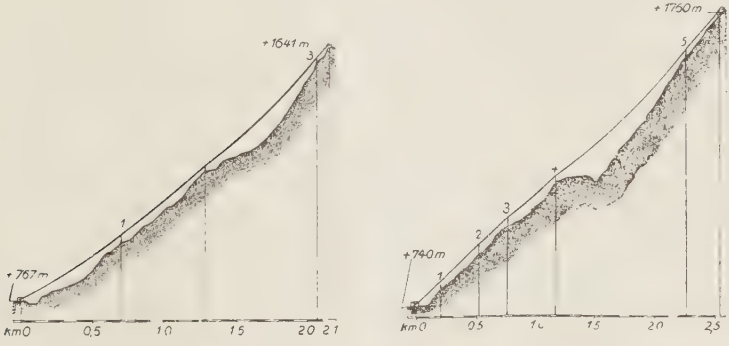
LEADING DIMENSIONS OF RACK LOCOMOTIVES.

Type			0-6-2-T	0-6-2-T	0-6-2-T	—	—
Administration			Ilmenau.	Bavaria.	Bavaria.	Wurtemberg.	Wurtem
Cylinders	diam.	mm.	2×470	2×460	2×480	2×420	2×4
		in.	(18 1/2")	(18 1/8")	(18 7/8")	(16 1/2")	(22
	do.	mm.	420—450	...	...	...	...
		in.	(16 1/2" — 17 11/16")	...	...	...	...
	piston stroke	mm.	500	508/508	508/508	612/540	560/
		in.	(19 11/16")	(20"/20")	(20"/20")	(30"/21 1/4")	(22"/
Boiler pressure		kgr./cm².	12	12	13	14	1
		lb./sq. in.	(170.7)	(170.7)	(184.9)	(199.1)	(199
Grate area		m².	2.11	1.82	2.0	1.40	2.
		sq. ft.	(22.7)	(19.6)	(21.5)	(15.1)	(20
Heating surface		m².	122.8	69.0	81.06	112.4	11
		sq. ft.	(1322)	(743)	(872.5)	(1210)	(120
Superheating surface		m².	0	37.0	25.4	0	42
		sq. ft.	...	(398)	(273.4)	...	(45
Water capacity		m³.	4.8	4.0	4.0	4.2	7
		Br. gall.	(1056)	(880)	(880)	(924)	(1
Coal capacity		tons	1.2	1.6	1.7	1.0	3
Wheels	diam.	m	1.080	1.006	1.006	1.230	1.
		ft. in.	(3' 6 1/2")	(3' 3 19/32")	(3' 3 19/32")	(4' 7/16")	(3' 9
	do.	m	0.688	0.800	0.800	0.945	
		ft. in.	(2' 3")	(2' 7 1/2")	(2' 7 1/2")	(3' 1 13/64")	
Weight	empty	metr. t.	...	48.3	50.4	43.7	6
		Engl. t.	...	(47.5)	(49.6)	(43.0)	(6
	total	metr. t.	55.9	57.8	59.9	54.1	7
		Engl. t.	(55.0)	(56.9)	(59.0)	(53.2)	(7
	adhesive	metr. t.	...	46.2	46.7	42.0	7
		Engl. t.	...	...	...	...	
Max. speed	adhesion	km./h.	...	45	45	50	
		m. p. h.	...	(28)	(28)	(31)	(3
	rack	km./h.	...	...	...	20	
		m. p. h.	...	...	...	(12.4)	(1

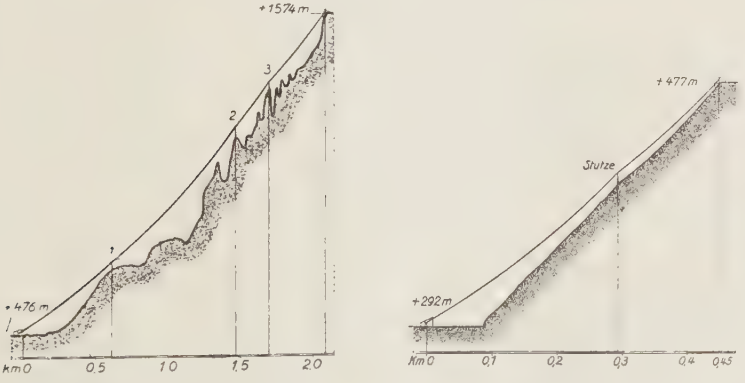
passenger traffic (fig. 377) are noted for their speed which is 5 m. (16.4′) per sec. on the *Kreuzeckbahn* (Garmisch), the *Wankbahn* (Partenkirchen) and the *Predigstuhlbahn* (Bad Reichenhall), all of which are in southern Bavaria. other countries such high speeds are or found on the *Montserrat* (Spain) a *Santète Lanchetta* telphers, which we also built by Messrs. *Bleichert*.



The two Zugspitze telpher lines.
a) Bavarian side. *b)* Tyrolese side.



The two Garmisch-Partenkirchen telpher lines.
Kreuzeckbahn. Wankbahn.



The Predigstuhlbahn at Reichenhall (Upper Bavaria). The Burgbergbahn at Bad Harzburg (Northern Germany).

Fig. 377. — Longitudinal section of a few telpher lines built by *Bleichert*.

TABLE 304*b*.

Type			0-6-2-T		2-8-2-T	2-10-2	2-10-2
Company			Prussia.	Harz (1).	Reichsbahn. (2).	Halberstadt-Blankenburg.	Reichsb (4).
Cylinders	diam.	mm.	470	450	2×520	700	700
		in.	(18 1/2")	(17 11/16")	(20 1/2")	(27 1/2")	(27 1/
	do.	mm.	500	300	...	...	...
		in.	(19 11/16")	(11 13/16")	...	...	...
	piston stroke	mm.	420	600/600	500/500	550	660
		in.	(16 1/2")	(23 11 5/8")	(19 11/16/ 19 11/16")	(21 11/16")	(26"
Boiler pressure		kgr./cm².	12	10	14	14	14
		lb./sq. in.	(170.7)	(142)	(199.1)	(199.1)	(199.
Grate area		m².	2.12	1.87	2.865	3.96	4.3
		sq. ft.	(22.8)	(20.1)	(30.8)	(42.6)	(46.
Heating surface		m².	123.3	136.0	119.7	180.86	200
		sq. ft.	(1327)	(1463)	(1288)	(1946)	(215
Superheating surface		m².	...	...	39.8	54.14	62.3
		sq. ft.	...	...	(428.4)	(582)	(67
Water capacity		m³.	5.5	4.5	3.0	8.8	12.
		Br. gall.	(1210)	(990)	(660)	(1935)	(264
Coal capacity		tons	2.1	2.0	3.0	3.0	4.(
Wheels	diam.	m	1.080	1.250	1.100	1.100	1.400
		ft. in.	(3' 6 1/2")	(4' 1 3/16")	(3' 7 5/16")	(3' 7 5/16")	(4' 7
	do.	m	0.800	0.573	0.800	0.850	...
		ft. in.	(2' 7 1/2")	(1' 10 9/16")	(2' 7 1/2")	(2' 9 1/2")	...
Weight	empty	metr. t.	48.3	45.7	80.7	79.0	103
		Engl. t.	(47.5)	(45.0)	(79.4)	(77.7)	(101
	total	metr. t.	59.1	55.9	94.3	100.0	125
		Engl. t.	(58.0)	(55.0)	(92.2)	(98.4)	(123
	adhesive	metr. t.	44.0	43.5	66.4	75.0	93
		Engl. t.	(43.0)	(42.6)	(65.3)	(73.8)	(91
Max. speed	adhesion	km./h.	50	...	55	...	...
		m. p. h.	(31)	...	(34.2)	...	...
	rack	km./h.	20	...	20	...	No
		m. p. h.	(12.4)	...	(12.4)	...	...

(1) 1885 type.
(2) *Borsig* 1922 type.
(3) Total wheelbase 11.90 m. (39' 1/2"); rigid : 3.30 m. (10' 10
(4) Type 20.

The Zugspitze, the highest peak of the Bavarian Alps, and in fact in Germany, is served by two telpher lines one on the Bavarian side and the other in the Austrian Tyrol. The first climbs from 2 67 m. (8 763') above sea level where th

lectric rack railway ends (*), to the ugspitzgipfel 2 950 m. (9 688′) above atum. The second climbs from 1 227 to 803 m. (4 025′ to 9 196′) above sea level. he length of these two lines is 732 and 373 m. (0.45 and 2.09 miles) respectiely, and the speed on both 4 m. (13.1′) er sec. The second is one of the longest elpher lines in the world, only the *Nelhornbahn*, and the *Patscherkofelbahn* 3 737 m. = 2.32 miles) being longer, ut the *Zugspitzbahn* makes good the largest difference in altitude : 1 576 m. 5 170′) (**).

CHAPTER LIII.

The train ferries.

LIII-1. — **River services.** — Whilst vaiting for large bridges to be built, train erries were provided at the mouths of ome of the great rivers, and later on cross the rivers themselves, and then ver some straits.

The first train ferries or ferryboats were introduced in England, in 1851, over the 8.8 km. (5.5 miles) wide Firth of Forth, and the next year over the 1.4 km. (0.87 mile) wide Firth of Tay; they continued in service until their replacement by the bridges built by the *North British Ry.*, 2 529 m. and 3 286 m. (1.57 and 2.04 miles) long respectively. Other train ferries were soon put into service at the mouth of the Humber between Gainsborough and Hull.

In 1897, at the mouth of the Mersey, Liverpool was linked up with Birkenhead in the same way by means of ferryboats with a screw propellor at each end, and Glasgow with Fenniestown on the Clyde.

The « Fenniestown » with four screws, built in 1898, was pontoon shaped :

Length	24.30 m.	(79′ 9″)
Width.	13 m.	(42′ 8″)
Draught	2.90 m.	(9′ 6 1/4″)

By means of a double-track movable bridge 23.70 m. (77′ 9″) long and 9.75 m. (32′) wide, 8 passenger carriages or 3 goods wagons together with 300 passengers were loaded unto each of the two

(*) This railway cannot be included among the mixed rack and adhesion railways we have been dealing with. It is only a metre-gauge secondary tourist line. The first section from Garmisch (705 m. = 2313' above sea level) to Grainau (at the 5.8th km.) is a simple adhesion section and the gradients do not exceed 1 in 27.

The rack section as far as Eibsee (10.8th km.) and Riffeleis (14th km.) uses 1 in 6.7 gradients, and from this latter to the top at Schneefernerhaus, at the 18.3rd km., even in the 4 466-m. (2.78 miles) long tunnel, 1 in 4 gradients. In this way it climbs to 2 650 m. (8 694'), which altitude it reaches in one hour from Riffeleis, i. e. at an average speed of 6.3 km. (3.9 miles) an hour. The telpher line starts at Schneefernerhaus.

The four-wheeled rack locomotive with three gear wheels weighs 28.7 t. (28.2 Engl. tons) and develops a tractive effort of 15 tons at 9 km. (5.6 miles) an hour. As far as Eibsee it hauls three 8.7-ton bogie vehicles each containing 54 seats, and beyond Eibsee two. The dead weight per passenger is thus 338 and 427 kgr. (745 and 941 lb.) including the locomotive.

(**) The *Nebelhornbahn* runs from Oberstdorf (843 m. = 2 969' above sea level) to Nebelhorn (1 932 m. = 6 338').

The *Fichtelberg* telpher climbs from from Oberwiesenthal (Saxony) 905 m. (2 969') above sea level to an altitude of 1 212 m. (3 976'). This was the first German telpher line.

The *Loschwitz* telpher (Dresden) 280 m. (0.17 mile) long climbs from 115 to 199 m. (377' to 653') above sea level.

The *Burgberg* telpher, at Bad Harzburg, climbs from 291 to 486 m. (955' to 1 594') above sea level.

tracks, so that in this way 700 passengers in all could be carried.

All these train ferries were loaded by means of inclined planes, except the Ruhrort ferry, where lifts were used.

On the Rhine, the first train ferries, which were practically contemporary with the English ones, usually only carried goods wagons. The Ruhrort-Homberg train ferry, where the boats were towed by a tug, was put into service in 1852, and was followed by the Bingerbrück - Rüdesheim, Rheinhausen-Hochfeld, Griethausen-Elten and Bonn-Obercassel ferry services, for passenger carriages and goods wagons.

A service between Lauenburg and Hohnsdorf was introduced over the Elbe in 1868, and soon followed by a service between the Stralsund and the Rügen Island, which remained in operation until October 1936.

On the Danube, south of the junction with the Drave, the first passenger and goods ferry service was introduced between Erdöd, near Gombos and Dalya.

LIII-2. — **Lake services.** — The first of these services was introduced on the Lake of Thoune in 1875. There have been services on the Lake of Zurich since 1885 and on the Lake of Lucerne since 1890. In 1898 single-track screw boats were introduced, 42 m. (137′ 9″) long and 6.70 m. (22′) width, with a draught of 1.10 m. (3′ 7 5/16″); they could carry 5 wagons.

At the same time Bavarian ferryboats were introduced between Lindau and Romanshorn on Lake Constance, which later on possessed the most important European services of the kind. These new units were quite different from the older ones, and much more powerful, with a capacity of 16 to 18 wagons. They were two-track paddle boats whose draught could vary according to the water level in appropriate tanks.

Length	75 m. (246′)
Width between	18 m. (59′)
Minimum draught . . .	1.7 m. (5′ 7″)

There were also lighters for 8 to 10 wagons, which were loaded by the stern; their dimensions were as follows :

Length . . .	41 to 48 m. (134′ 6″ to 157′ 5″)
Width . . .	9.20 m. (30′ 2″)
Displacement	120 to 140 tons.

LIII-3. — **Sea services.** — Three services of this kind serve German ports (fig. 378) :

(a) a German service from Stralsund to the Rügen Island;

(b) a Germano-Swedish service which is a continuation of *(a)*, from Sassnitz to Trälleborg;

(c) a Germano-Danish service, between Warnemünde and Gedser.

(a) As the RÜGEN ISLAND is nearer Sweden than any other part of Germany, it has long been the link between maritime services to these two countries. This service was linked up with the rest of the German Empire by a railway line between the island and the coast. The distance from the port of Sassnitz to the straits was 46.5 km. (28.9 miles) as far as Altefähr at which place the 2 743 m. (1.7 miles) long crossing to the port of Stralsund, 3.2 km. (2 miles) from the town, began. The crossing, including loading and unloading, took about 26 minutes.

As the tides were very small it was possible to use a 20-m. (65′ 7″) lift bridge to load the goods wagons, which alone made the through journey, unto the first ferry-boats, the « Prinz Heinrich » and the « Rügen ». These twin-screw boats, built by Messrs. Schichau, were

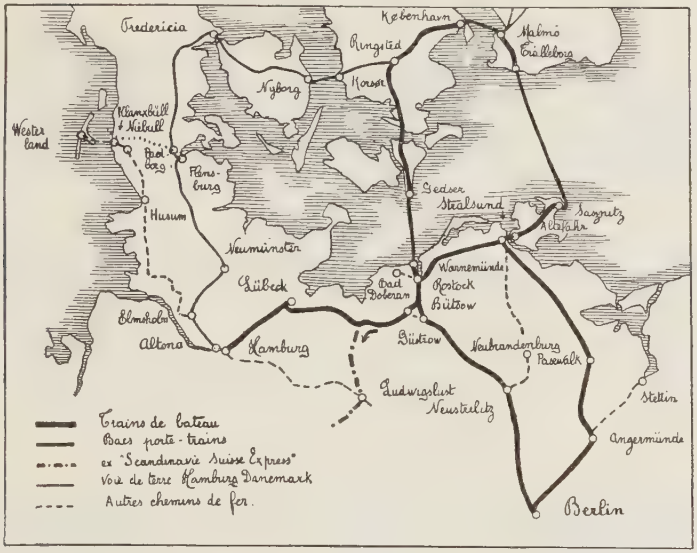


Fig. 378. — Route of German ferryboats and of the *D.-Züge* whose coaches use them.

Note:

Boat trains.
Train ferries.
Former « Scandinavia-Switzerland Express ».
Hamburg-Denmark land route.
Other Railways.

35 m. (114′ 10″) long, 7.40 m. (24′ 3 3/8″) wide, with a draught of 1.50 m. (4′ 11″), and could carry 60 tons with a displacement of 300 tons, and a speed of 8.1 knots. They were double-track boats, and in 1890 another identical boat, the « Stralsund » was built.

When preparing to introduce a new ferryboat service to Sassnitz, it was decided to improve the Rügen service. To do this, new docks were built in 1894, with 25-m. (82′) lift bridges, which reduced the gradient to 1 in 20 at high tide and 1 in 17 at low tide, instead of 1 in 25 and 1 in 13 respectively.

In order to speed up the service, it was decided to replace the dike linking up the Rügen Island with the mainland by a 2.92-km. (1.81 miles) long dike with two bridges, one 125 m. (411′) long over the Ziegelgraben, and the other 500 m. (1 640′) long over the Strelasund. Besides the railway line there is a road 6 m. (19′ 8″) wide and a 3-m. (9′ 10″) wide footpath. This work has just been completed, and the journey from Stralsund to Sassnitz will only take 1 hour instead of 1 hour 40 minutes, which will be taken advantage of to revise the timetables of the international trains between Germany and Scandinavia.

Figure 379 shows the cross section of this dike as well as that across the Sylt—which we will deal with in connection with services to seaside places. We also reproduce (fig. 380) a cross section of

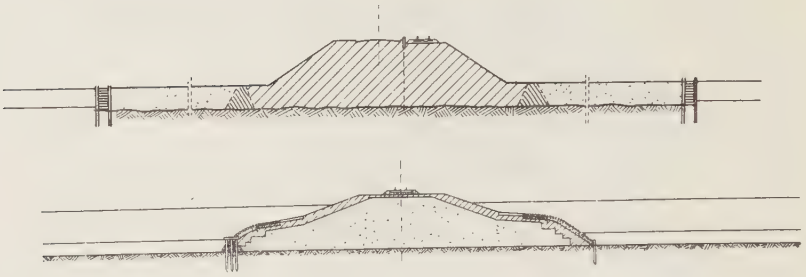


Fig. 379. — Cross sections of dikes joining the mainland to certain islands : *(a)* the Rügen dike; *(b)* the Sylt Isle dike.

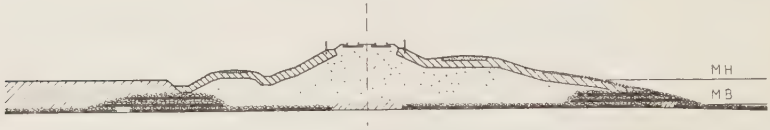


Fig. 380. — Cross section of the dike of the Beveland Isle.

the Dutch dike between the island of Beveland and the main land.

(b) GERMANO-DANISH FERRY-BOATS. — When dealing with the Danish services, we included information on the ferry-boats working the Warnemünde-Gedser service as well as on the through services they make possible with Denmark (cf. *Bulletin of the Railway Congress*, June 1936, pp. 640/618 et seq.).

These services date from the 1st October 1903, Denmark having purchased the previous year the maritime line between these places. After the service was inaugurated there was such an increase in traffic, not only towards Denmark, but also of through traffic towards the Scandinavian peninsula, to the detriment of the steamboat service between Sassnitz and Trälleborg, that six years later this service was also converted into a ferry-boat service.

The Warnemünde ferry-boats giv through services by means of through coaches between Berlin Stett. and Ham burg and Copenhagen.

At Warnemünde the time taken to loa a passenger carriage unto the train ferr is 25 minutes from the time it is un coupled. To complete the load, a brak van and mail van as well as goods wagon are also taken on board. The timetable allow 26 minutes at Wärnemünde fro the arrival of the train to the departu of the ferry, and 29 minutes at Sassnit In the other direction, from the arriv of the boat to the departure of the trai 20 minutes are allowed at Warnemünd and 22 at Sassnitz.

To complete the information previou ly given about the Danish train ferr boats (see *Bulletin*, June 1936, p 640/618 et seq.), we give, in table 30 the leading dimensions of the Germa boats used in this service.

TABLE 305.

LEADING DIMENSIONS OF GERMAN FERRYBOATS.

Boat Date built	MECKLEMBURG. (1903).	SCHWERIN. (1926).
Length	86 m. (282' 2")	106 m. (347' 9")
Maximum width outside fenders.	17.70 m. (58' 1")	18.53 m. (60' 9 1/2")
Width amidships	14.0 m. (45' 11")	16.0 m. (52' 6")
Draught under load	4.50 m. (14' 9")	4.50 m. (14' 9")
Average working speed	12.5 naut. miles.	12.5 naut. miles.
Maximum speed.	13 naut. miles.	15.5 naut. miles.
Useful track length	130 m. (426' 6")	161.4 m. (526')
Engine power.	2 500 H.P.	4 500 H.P.

(*c*) GERMANO-SWEDISH FERRYBOAT SERVICE. — To compete with the Danish train ferry services, the German and Swedish Governments converted their packet boat service they had worked since 1896 between Sassnitz and Trälleborg into a train ferry service. For this purpose they ordered from Messrs. Schichau the « Sassnitz », which made its first crossing on the 6th July 1909. Since then the lift bridges were extended by 25 m. (62') to reduce their slope from 1 in 35 to 1 in 40 according to the tide.

The ferryboat was 65 m. (213' 3") long, 61.55 m. (202') being available for the vehicles on two tracks. The other leading dimensions were as follows :

Width.	9.30 m. (30').
Draught	2.10 m. ((6' 10 11/16").
Loading capacity.	155 tons.
Capacity of bunkers.	20 tons.
Moulded depth (ins.).	3.20 m. (10' 6").
Power	500 H.P.

There are two propellors as well as a rudder at each end. The speed, like that of the Rügen ferryboats, is 8.1 knots.

In the chapter dealing with Sweden (*Bulletin*, August 1936, pp. 780/698 et seq.) we gave some further information on the Swedish participation in this service, as well as the connections it makes possible between Trälleborg, Malmö, Oslo and Stockholm.

On the Continent, the line is linked up by *D* trains to Stralsund, and thence on the one hand to Berlin Stett., and on the other to Hamburg. These trains include through coaches for each class (as well as sleeping cars from Malmö) between Stockholm and Oslo on the one hand, and Berlin and Hamburg on the other. The timetables are given in Table 306.

We have already quoted two cases of places linked up by a mixed rail and water service on the one hand, and on the other by a railway service going round by land and consequently competing with the former between these same places. These were the services between Amsterdam and Leeuwarden, and between Copenhagen and Aarhus. A third example is to be found in the services between Hamburg and Copenhagen, by the mixed route using the Warnemünde-Gedser ferryboats on the one hand, and the Storrebelt ferryboats and the railway

TABLE 306.

TRAINS CONNECTING WITH THE FERRYBOAT SERVICES.

RUN.	Distance. Km	Distance. Miles.	Time of Departure.	Time spent.	Speed. Km./h.	Speed. M.p.h.
SASSNITZ-TRÄLLEBORG	107	66.5	2.10 a. m.	4.10	25.7	16 0
Berlin Stett.-Sassnitz-Stockholm	1 031	640.6	8.50 p. m.	19.07	53.9	33 5
Berlin Stett. Sassnitz-Oslo	1 189	788.5	Do.	22.45	50 9	31 6
Berlin Stett.-Sassnitz	294	182.7	Do.	4.51	60 6	37.6
Hamburg-Rostock-Sassnitz-Stockholm	1 058	657.4	7.49 p. m.	20.08	52 2	32 4
Hamburg-Rostock-Sassnitz-Oslo	1 216	755.6	Do.	23.48	51.2	31.8
WARNEMÜNDE-GEDSER	45	28 0	2.50 a. m.	2.05	21.6	13.4
Berlin Stett.-Warnemünde-Copenhag.	453	281.5	6.19 p. m.	10.42	42.3	26.3
Hamburg-Warnemünde-Copenhagen	431	267.8	R 10.30 a. m.	9.12	46.8	29.1
Hamburg-Fredericia-Copenhagen	545	338.7	9.32 p. m.	10.21	51.8	32.2

from Fredericia on the other hand. That is why we mentioned this case as a matter of comparison.

CHAPTER LIV.

The trains.

LIV-1. — **Classes of trains.** — In Germany there are four classes of fast trains : the *FD*, *D*, *L* and *E* trains.

(a) The *FD* trains (Ferndurchgangszüge), introduced on the 1st June 1923, are long-distance trains only stopping at long intervals. These fast trains have only two classes — 1st and 2nd — and a supplement is charged.

In 1929 there were 15 *FD* trains (in both directions), 10 starting from Berlin (1), completed by two rakes from Hamburg (2), a Bremen-Frankfort train made up in the same way (3), and two *FD* trains to Holland, one from Berlin to the Hook of Holland and the other a train from Switzerland to Holland (4). The latter alone was classed as an *FFD* train, as it was made up entirely of saloon-cars.

The following sleeping-car trains were also being run :

FD 16/15 — Berlin-Cologne.
FD 70/71 — Berlin-Munich.
D 4/3 — Frankfort-Basle.

The *FD* trains are now subdivided into two classes according to the service required from them. The first, which includes the original trains, gives fast services between centres, which may be

(1) As follows :

FD 4/3 Berlin-Frankfort. *FD* 24/23 Berlin-Hamburg.
FD 6/5 Berlin-Basle. *FD* 26/25 Berlin-Hamburg.
FD 12/11 Berlin-Stuttgart. *FD* 80/79 Berlin-Munich.
FD 22/21 Berlin-Cologne. *FD* 31/30 Berlin-Beuthen and Oderberg.

(2) *FD* 26/25 Berlin-Aix la Chapelle interfering with *FD* 226/225 Hamburg-Cologne.
FD 92/91 Berlin-Basle interfering with *FD* 192/191 Hamburg-Basle.

(3) *FD* 154/153 Bremen-Frankfort interfering with *D* 54/53 Hamburg-Frankfort.

(4) Train *FD* 112/111, formerly a « de luxe » train and, from Basle, « The Rheingold » (*FFD* 102/101).

Fig. 381. — Routes of *FD* trains.
Obsolete *FD* train routes are shown by bar lines.

very far apart, for the benefit of the general public; 9 trains of this kind are still in operation (fig. 381), 6 of them linking up Berlin with important provincial towns (1) and 3 serve Holland, from Berlin, Munich, and Switzerland via Basle.

(*b*) *FDt* trains. — The second series of *FD* trains was introduced for the be-

(1) Hamburg-Altona, Aix-la-Chapelle, Cologne, via Wuppertal, and via Hamm, Frankfort and Munich.

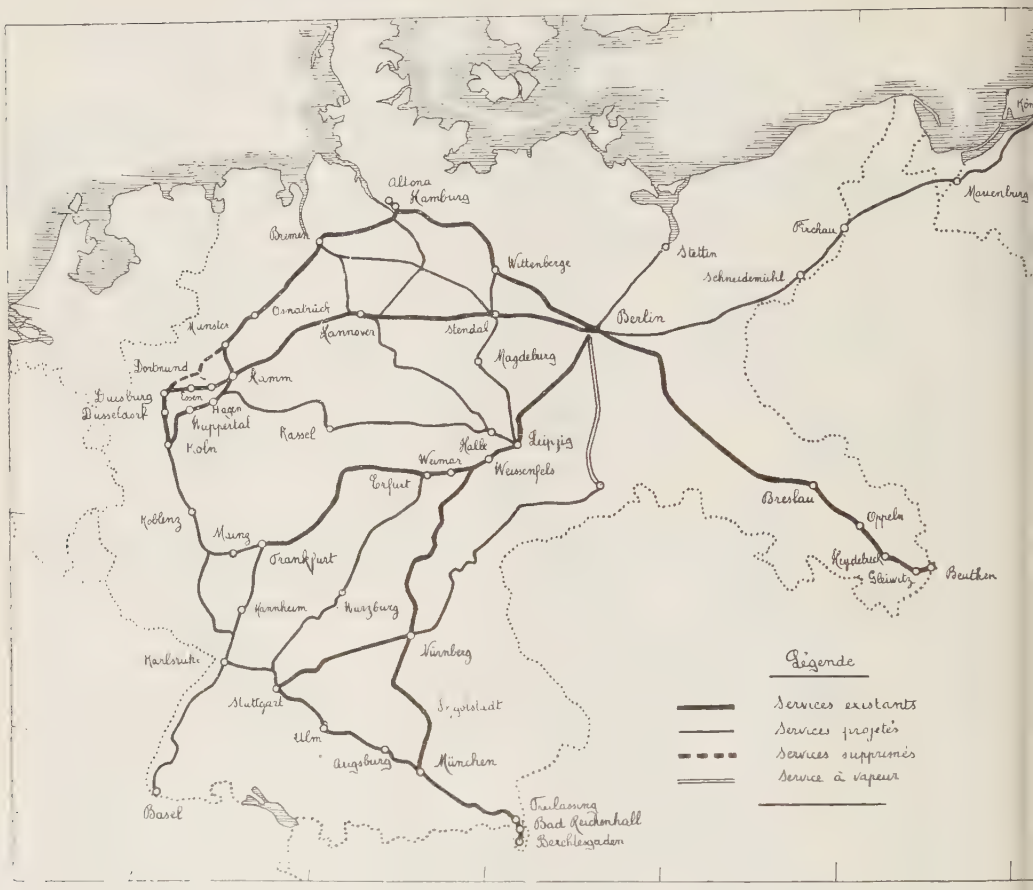


Fig. 382. — *FDt* train routes.

Explanation:

existing services; — obsolete services;
projected services; — steam services.

nefit of business men. These are ultra high-speed trains which make it possible for the passengers to leave home in the morning, work all the afternoon at the place they are visiting and return home in the evening. It has been found possible to run such services between places as far apart as Cologne and Berlin, which are only 53 km. (33 miles) nearer to each other than Edinburgh and London.

With the exception of two pairs of steam trains hauled by streamlined locomotives (Berlin-Hamburg-Altona and Berlin-Dresden), ultra high-speed rail-cars are used for all these services, designated *FDt* (1). They consist of two or three-unit sets of one class only (2nd) with a buffet.

The first diesel rake became famous

(1) *t* = *triebwagen* = railcar.

nder the name of « Flying Hamburger » and was the first of many such ets, not only in Germany but also broad. In Germany, *Die Reichsbahn* published, as far back as 1934, under the signature of Dr. Leibbrand (2) the programme of fast diesel services showing the saving in time they made possible as compared with the best timetables of that date.

TABLE 307

BOOKED RUNS OF FAST RAILCARS (fig. 382).
(Services not existing so far are shown in *italics*.)

Seq. No.	RUN.	Distance. Km.	Distance. Miles.	Time spent at present.	Booked time of railcar run.
	Diesel railcars.				
1	Berlin-Hamburg.	287	178.3	2 h. 34	2 h. 18
2	Berlin-Cologne	579	359.8	7 h. 40	5 h.
3	Cologne-Hamburg	450	279.6	5 h. 57	4 h. 15
4	Berlin-Leipzig	165	102.5	1 h. 49	1 h. 22
5	Berlin-Dresden	180	111.8	2 h. 29	1 h. 39
6	Berlin-Breslau	341	211.9	4 h. 03	2 h. 51
7	Berlin-Munich	674	418.8	8 h. 23	6 h.
8	Berlin-Frankfort/Main . . .	539	334.9	6 h. 48	4 h. 45
9	*Frankfort/Main-Karlsruhe* . .	507	315.0	8 h. 27	6 h. 29
10	*Berlin-Bremen*	339	210.7	4 h. 15	2 h. 45
11	*Frankfort/Main-Basle* . . .	338	210.0	5 h. 14	3 h. 20
12	*Hamburg-Frankfort/Main* . .	563	349.8	8 h. 15	5 h. 22
13	*Berlin-Erfurt-Stuttgart* . . .	652	405.1	10 h. 55	7 h. 21
14	*Hamburg-Magdeburg-Leipzig* .	404	251.0	5 h. 01	3 h. 35
15	*Bremen-Hanover-Leipzig* . . .	392	243.6	6 h. 11	3 h. 45
16	*Dresden-Nuremberg.*	394	244.8	7 h. 15	5 h. 42
17	*Berlin-Königsberg*	600	372.8	10 h. 47	5 h. 10
18	*Berlin-Stettin.*	135	83.9	1 h. 48	1 h. 08
19	*Cologne-Kassel-Leipzig* . . .	552	343.0	8 h. 52	6 h. 56
20	*Cologne-Stuttgart*	402	249.8	6 h. 36	4 h. 15
	Electric motor coach.				
21	Stuttgart-Munich Berchtesgaden .	395	245.4	5 h. 20	3 h. 30

(c) THE *L* TRAINS are « de luxe » trains perated by the *International Sleeping-Car Company;* those of the *Mitropa* (the Scandinavia-Switzerland Express » and he « Berlin-Hook of Holland Express ») ave been discontinued. They are usually eavy trains, so the timings are less xacting than those of the *FD* trains; on he other hand, they also run very long istances non stop.

(2) Number 10, pp. 246/247.

The whole of these fast trains includes 26 pairs (in both directions) grouped as follows :

9 *FD* trains running over 3 091 km. (1 920.7 miles) of line;

11 *FDt* trains running over 3 086 km. (1 917.6 miles) of line;

6 *L* trains running over 3 423 km. (2 127 miles) of line.

The details of these services are given in Table 308.

TABLE 308

HIGH-SPEED TRAINS.

Trains.	RUN.	Distance.		Time spent.		Speed.			
						Outward.		Return.	
		Km.	Miles.	Outw.	Return.	Km./h.	M.p.h.	Km./h.	M.p.h.
FD trains.									
102/101	Holland-Switzerland *(Rheingold)*	648	402.7	7.47	8.21	83.2	51.7	77.6	48.3
265/263	Holland-Munich	767	476.6	9.53	9.48	77.6	48.2	78.3	48.7
24/23	Berlin-Hamburg-Altona.	294	182.7	2.42	2.42	108.9	67.7	108.9	67.7
26/25	Berlin-Aix la Chapelle	681	423.2	7.35	7.42	89.8	55 8	88.2	54 8
226/225	Berlin Hamm-Wuppertal-Cologne branch	120	74.6	1.33	1.37	77.4	48.1	74.2	46.1
22/21	Berlin-Cologne (via Duisburg)	588	365.4	6.50	6.59	86.0	53.4	84.2	52.3
6/5	Berlin-Frankfort (via Erfurt)	550	341.8	6.28	6.15	85 0	52.8	88.0	54.7
112/111	Berlin-Hook of Holland	465	288.9	5.46	5.22	80.7	50.1	90.0	55.9
80/79	Berlin-Munich	675	419.4	7 53	7.43	85.6	53.2	87.5	54.4
FDt trains.									
70/71	Berlin A.-Munich (via Halle-Nuremberg)	686	426.3	6.36	6.40	103.9	64.5	102.9	63.9
38/37	Altona-Hamburg-Cologne (via Duisburg)	479	297 6	4.45	4.35	100.9	62.7	104.5	64.9
2/1	Berlin L.-Hamburg-Altona.	294	182.7	2.37	2.37	113.5	70.5	113.5	70.5
45/46	Berlin Stadtbahn-Beuthen.	511	317.5	4.50	4.52	105.7	65.7	105.0	65.3
572/571	Berlin A.-Frankfort (via Leipzig-Nuremberg).	550	341.8	5.03	5.03	108.9	67.7	107.2	66.6
16/15	Berlin Stadtbahn-Cologne (via Duisburg)	588	365.4	5.11	5 31	111.7	69.4	106.6	66.2
18/17	(Berlin) Hamm-Wuppertal-Cologne branch	120	74.6	1.21	1.21	88.9	55.2	88.9	55.2
552/551	Berlin A.-Munich (via Leipzig-Nuremberg)	686	426.3	6.36	6.40	103.9	64.5	102.9	63.9
712/711	(Berlin A.) Nuremberg-Stuttgart branch	190	118.1	2 14	2.15	85.8	53 3	84.5	52 5
720/719	Munich-Stuttgart	240	149.1	2.24	2.30	100.0	62.1	96.0	59.7
721/720	Stuttgart-Berchtesgaden (via Munich)	421	261.6	5 34	5.14	75.6	47.0	80.5	50 0
L trains.									
12/11	Aix la Chapelle-Berlin Stadtbahn-Neu Bentschen *(Nord Express)*	806	500.8	10.50	10.40	75.5	46.9	73.6	45.7
105/106	(Kehl) Stuttgart-Eger *(Paris-Prague Express)*.	343	213.1	5.23	4.59	63.7	39.6	68.8	42.7
52/51	Aix la Chapelle-Passau *(Ostend-Vienna Express)*	755	469.1	10.21	10.48	72.9	45.3	69.5	43.2
5/6	Kehl-Stuttgart-Salzburg *(Orient Express)*	559	347.3	7.28	7.51	74.8	46.5	69.9	43.4
D trains.									
	Aix la Chapelle-Cologne Hbf. *(Pullmann Express)*	71	44.1	0.54	0.51	78.9	49.0	83.5	51.9

(d) The *D* trains (durchgehende Züe) are three-class express trains, introuced on the 1st May 1892. They were ıade up of bogie stock — which was an ınnovation at that date. The German ractice of making up these trains of othing but such stock contributed larely to the development of this excellent ınnovation.

These trains ran fairly long distances, ften non-stop, at high overall speeds, eaching even 105 km. (65.3 miles) an our. However, the German custom of reıarshalling the trains several times durıg the journey to enable through aches to be used lengthens the stopping mes, so that the overall speed for the hole journey is markedly lower.

At the present time, though there are ıree classes on most of these trains, me of them only include 2nd- and 3rdass compartments. Most of the day ains include a restaurant-car, and most the night trains one or several sleepıg cars. They are usually very heavy ains, 500 or 600 tons not being exceponal.

Although they generally run very long stances, the working of the through aches makes it necessary to have *D* nnecting trains, some of which are only ort-distance trains. For example *D* 302 ly runs 10 km. (6.2 miles), and *D* 326 km. (4.35 miles). They are still classed as *D* trains, however, on account of e rates.

One of the good results of the general eeding up is that the traffic increases d is won back to the railway. This is iversally so; in England, for example, r. Bell, Assistant General Manager of e *L.N.E.Ry.*, said some time ago that wished the « Silver Jubilee Express » hich makes 12 shillings a mile whereas most passenger trains only make 2 sh 6 d., could carry a quarter more passengers.

The proportion of the German System run over by the fast *FD*, *D* and *L* trains is very large, owing to the fact that, apart from interprovincial services, they serve two or several alternative lines, and maintain high speeds to the most outlying parts of the country.

We calculated the mileage of these services in the 1936 summer and have added those in neighbouring countries for comparison *(see Table 309)*.

(e) The *E* trains (Eilzüge) are fast trains with 2nd and 3rd-class compartments only, and frequently include a buffet car. They are slower than the *FD* trains, are sometimes as fast as the *D* trains, but stop more frequently. On the other hand, they are not re-marshalled so often during the journey. The fastest overall speed for an *E* train seems to be 91 km. (56.5 miles) an hour, on the Berlin-Görlitz line.

As on the *D* and *FD* trains a supplement is charged on the *E* trains, though the amount is smaller. These supplements are based on zones of 75 km. (46.6 miles). On the *E* trains, a supplement of 0.25 Rm. per kilometre is charged for 3rd-class and twice as much for 2nd class, the same as for 3rd class on *D* trains, and four times as much for 2nd and 1st class on *D* trains. In addition on the *FD* trains, a fixed supplement of 2 Rm. is charged up to 300 km. (186 miles), and 3 Rm. over 300 km. *(see table 310)*.

(f) The *P* trains (Personenzüge) are the local trains. As from the 7th October 1928, when the 4th class was abolished, they were reduced to two classes only (2nd and 3rd).

TABLE 309.

DEVELOPMENT AND PERCENTAGE OF GERMAN LINES RUN OVER BY FAST TRAINS.

ADMINISTRATION OR COMPANY.	Km. (miles) of line run over by fast trains.		Total system.		
	Km.	Miles.	Km.	Miles.	Per cent.
GERMANY.					
Reichsbahn	21 729	13 502.0	53 883 (1)	33 481.9 (1)	40.3
Lübeck Companies	163	101.3	202 (2)	125.5 (2)	81.5
FRANCE.					
Nord	988	613.9	3 830	2 379.9	25.5
Est	1 566	973.1	5 132	3 188.9	30.5
Alsace-Lorraine	482	299.5	2 297	1 427.3	20.9
P.-L.-M.	4 129	2 565.7	9 947	6 180.9	41.6
P.-O.-Midi	4 115	2 557.0	11 315	7 030.9	36.4
State	4 190	2 603.6	9 210	5 722.9	45.5
Whole system	15 475	9 615.9	41 910 (3)	26 042.1 (3)	36.8
BELGIUM.					
« Trains-bloc » (975) and international trains	1 585	984.9	5 021 (4)	3 120.0 (4)	31.5
HOLLAND.					
D trains	1 095	680.4	3 128 (5)	1 943.7 (5)	35.0
ITALY.					
Rapidi	2 495	1 550.3	16 231 (6)	8 565.8 (6)	15.4

(1) Not including 903 km. (561.1 miles) of narrow-gauge lines.
(2) Not including 29 km. (18 miles) of secondary lines.
(3) Including 179 km. (111.3 miles) of the Circle Ry. (Ringbahn).
(4) Including 170 km. (105.6 miles) of *Nord-Belge* lines.
(5) Excluding 82 km. (50.9 miles) of tramway lines (Stadtbahn).
(6) Excluding 776 km. (482.2 miles) of 0.75-m. (2' 5 1/2") gauge lines .

TABLE 310.

SPEED SUPPLEMENTS.

Zone	1st	2nd	3rd	4th	5th
Km.	1-75	76-150	151-225	226-300	Over 300
	RM.	RM.	RM.	RM.	RM.
E trains.					
3rd class	0.25	0.50	0.75	1.—	1.25
2nd class	0.50	1.—	1.50	2.—	2.50
D trains.					
3rd class	Do.	Do.	Do.	Do.	Do.
1st and 2nd classes	1.—	2.—	3.—	4.—	5.—

The 4th class, introduced on the 1st ay, 1843, had already been abandoned the 1st May, 1853, but it was reintroced on the 4th April, 1864, and was nally done away with nine years ago.

LIV-2. — **Light trains.** — The *Bavaan State Rys.* were the first to make systematic investigation into the quesion of light trains, though such trains ad been run for some time on other nes (the *Belgian State,* in particular). Whereas the latter railway ran such ains solely for economy in traction, the *avarian Rys.* wished at the same time increase their passenger traffic by peeding up the services and making hem more frequent on secondary lines rst of all, and afterwards on the main nes as well.

The weight of the stopping trains hich was only 100 to 120 t. (98.4 to 18 Engl. tons) with 15 to 20 pairs of heels at the beginning of the century, y 1908 had become 300 to 400 t. (295 394 Engl. tons) with 40 pairs of wheels more. These excessively heavy trains st too much, and consequently could ot be run frequently enough.

It was then decided to introduce light ains which could be staffed by two en : the driver (acting as guard) and conductor or fireman. To shorten the ops, these trains carried neither mails, arcels, milk, nor cattle. In the case of e main lines, whereon they were introced in 1909, special stock was designed r these accessory services.

The first light trains, worked to the me timings as the ordinary local trains, n on the 24th September 1909 between unich and Nuremberg via Ingolstadt. heir number soon had to be increased 20 instead of 14 between Munich and Nuremberg, and 18 instead of 11 between Nuremberg, Ingolstadt and Treuchtlingen. In some cases some suburban stops were discontinued, which increased the traffic in the suburban zone, while in other cases the inner suburban district was extended as far as Rohrmoos (in the case of Munich) and Roth (in the case of Nuremberg); finally some of the trains passed certain small stations. For example light train No. 215 did not stop till it got to Ingolstadt, as a stopping train preceded it.

A special type of 4-4-0 locomotive connected to the brake van by a gangway was put into service (1); the usual 83-ton light trains consisted of a van (with a cattle compartment) and four large up-to-date coaches with 2nd and 3rd-class compartments.

It appears particularly interesting to recall these beginnings, as problems of that time were the same as the present-day ones and the traffic requirements were also identical. Under these conditions, one may wonder how it is possible that the railways, through overconfidence in their traffic monopoly, could remain blind to the dangers of road competition for such a long time. They only began to fight it by improving their own services when it had already entrenched itself in a position which a wise and progressive policy would never have permitted.

In 1935, 2-4-2-T engines were introduced to haul light trains and *Leig* trains composed of two coaches with 120 seats or two close-coupled wagons; these locomotives only had an axle load of 15 tons at most. With 1.50-m. (4′ 11″) diameter

(1) There were locomotive-vans in Belgium.

driving wheels (2), they could run at 80 km. (50 miles) an hour; with the diameter increased to 1.60 m. (5′ 3″) in the case of the new units, the speed was 100 km. (62 miles) an hour. The first locomotives took two minutes to reach their maximum speed.

The high pressure of 20 kgr./cm² (284 lb. per sq. in.) contributes to their power; the 60-mm. (2 3/8″) play on either side of the trucks adds to their flexibility, the coupled wheelbase only being 3 m. (9′ 10 1/8″).

LIV-3. — **Goods trains.** — To interpolate new fast trains on lines with heavy traffic, once the questions relating to the rolling stock and permanent way have been solved, raises some operating problems, chiefly on account of the diversity in the speeds of the different classes of trains. Endeavours have been made to reduce this divergency, even in the case of goods trains, and in the case of the latter the recent general use of the continuous brake has been of great assistance.

After lengthy tests on the Hamburg line, the basic speed of goods trains was fixed at 70 km. (43.5 miles) an hour, and in the case of trains formed of appropriate rolling stock, 75 km. (46.6 miles) an hour. With special wagons tested during the 1934 summer, the speed could be 90 km. (56 miles) an hour for trains hauled by P 10 locomotives.

For this speed two new standard types of locomotive were designed : a 2-8-2 *Schwartzkopff* locomotive for 800 to 900-ton trains, and a 2-10-2 *Henschel* locomotive for 1 500-ton trains.

Goods rail motor vans running at 130 km. (80.8 miles) an hour have also been designed, which will run in between the express trains.

(2) Their leading dimensions were as follows :

Cylinders	bore	0.310 m. (12 3/16″).
	stroke	0.660 m. (26″).
Boiler pressure		20 atm. (284 lb./sq.in.).
Heating surface		67.43 m² (725.8 sq. ft.).
Superheating surface		28.60 m² (307.8 sq. ft.)
Grate area		1.37 m² (14.7 sq. ft.).
Diameter of wheels		1.50 m. (4′ 11″).
		0.85 m. (2′ 9 1/2″).
Total wheelbase		8.40 m. (27′ 7″).
Rigid wheelbase		3 m. (9′ 10 1/8″).
Water capacity		7 m³ (1 540 Br. Gall.).
Fuel capacity		3 tons.
Length over buffers		11.8 m. (38′ 8 5/8″).
Adhesive weight		30 t. (29.5 Engl. tons).
Weight in working order		59 t. (58.1 Engl. tons).

Builder : *Berliner Maschinenbau A. G.*

CHAPTER LV.

The train services.

LV-1. — **Fast lines.** — Apart from the diesel sets and *FD* trains for which the number and duration of stops has been limited, on a certain number of important lines remarkable *D* train times have been introduced, consisting of a succession of high-speed stages. This applies not only to lines radiating from Berlin but to a certain number of interprovincial lines.

The fastest *D* train run is that of *D* 178, from Potsdam to Magdeburg, at 105.5 km. (65.6 miles) an hour.

Though the constant increase in the maximum speed is noteworthy, the generalisation of high speeds is of prime importance, and obviously it is better to increase the average speed of a large number of express trains between two given towns than serve them by two or three ultra high-speed trains, while the speed of the other trains remains indifferent. From this point of view, some of the German services are very remarkable. A few examples are given in Table 311.

Table 311.

AVERAGE COMMERCIAL SPEEDS BETWEEN TWO CITIES.

Run.	Distance.		*FD* trains only.				All *D* and *FD* trains.			
	Km.	Miles.	Number	Time spent.	Speed. Km. h.	Speed. M.p.h.	Number	Time spent.	Speed. Km./h.	Speed. M.p.h.
Berlin Lehrte-Hamburg .	290	180.2	2	2.20	124.3	77.1	6	3.00	96.7	60.1
Berlin Anhalt-Leipzig .	165	102.5	3	1.23	119.3	74.2	15	1.54	86.9	54.0
Berlin Zool.-Hamm . .	440	273.4	3	4.02	109	67.7	8	4.53	84.3	52.4
Stuttgart-Munich . . .	240	149.1	3	2.38	91.1	56.6	8	2.57	81.3	50 5

In this table we took into account all the *D* trains except one night train purposely run at a low speed.

LV-2. — **Main services.** — Germany more than any other country makes use of through coaches between innumerable places, which necessitates re-marshalling the trains during the journey. Whereas in most countries the passenger changes trains, in Germany the coaches change trains. The generalisation of this practice depends upon many factors, amongst which are the density of the population, and the number of passengers travelling between secondary centres.

With the German system, the stops in connecting stations, where the coaches are transferred, is necessarily long, and it is very important to regulate the working exactly, as the slightest delay has such wide reaching effects, owing to the sequence of the connections.

The train routes are just as complicated as those followed by the through coaches. Not only are there services from each place to a much greater number of places than in other countries, but there are often two, three or even four train routes to reach the same destination.

To make the effects of this operating method more clearly understood, we will give the characteristics of some *D* trains, the extent to which they serve the various districts, and will give other trains the timings of which are correlated with theirs and consequently interfere with them.

It should be noted, by the way, that in many cases the trains in connection bear the same number, only the hundreds figure differing. For example trains *D* 122, *D* 222 and *D* 322 connect with train *D* 22.

Ramifications of a basic train. — By showing all the trains starting from a basic train it is possible to draw a graph of all the interconnections with a second system of services, and so on. It must be remembered, however, that all these interconnections relate to a given period, and must all be revised if a new connection is to be added.

For the sake of clearness, let us take a given train, for example, the fast train *D* 33 from Berlin to Beuthen.

Figure 383 shows its route and those followed by the through coaches attached to, or detached from, this train during the journey. Whereas train *D* 33 itself runs 575 km. (357 miles), the distance covered by the through coaches, divided up among four *D* trains (*D* 333 - 125 - 25 - 201), is longer by 1 700 km. (1 056 miles), or 2 275 km. (1 413 miles) in both directions.

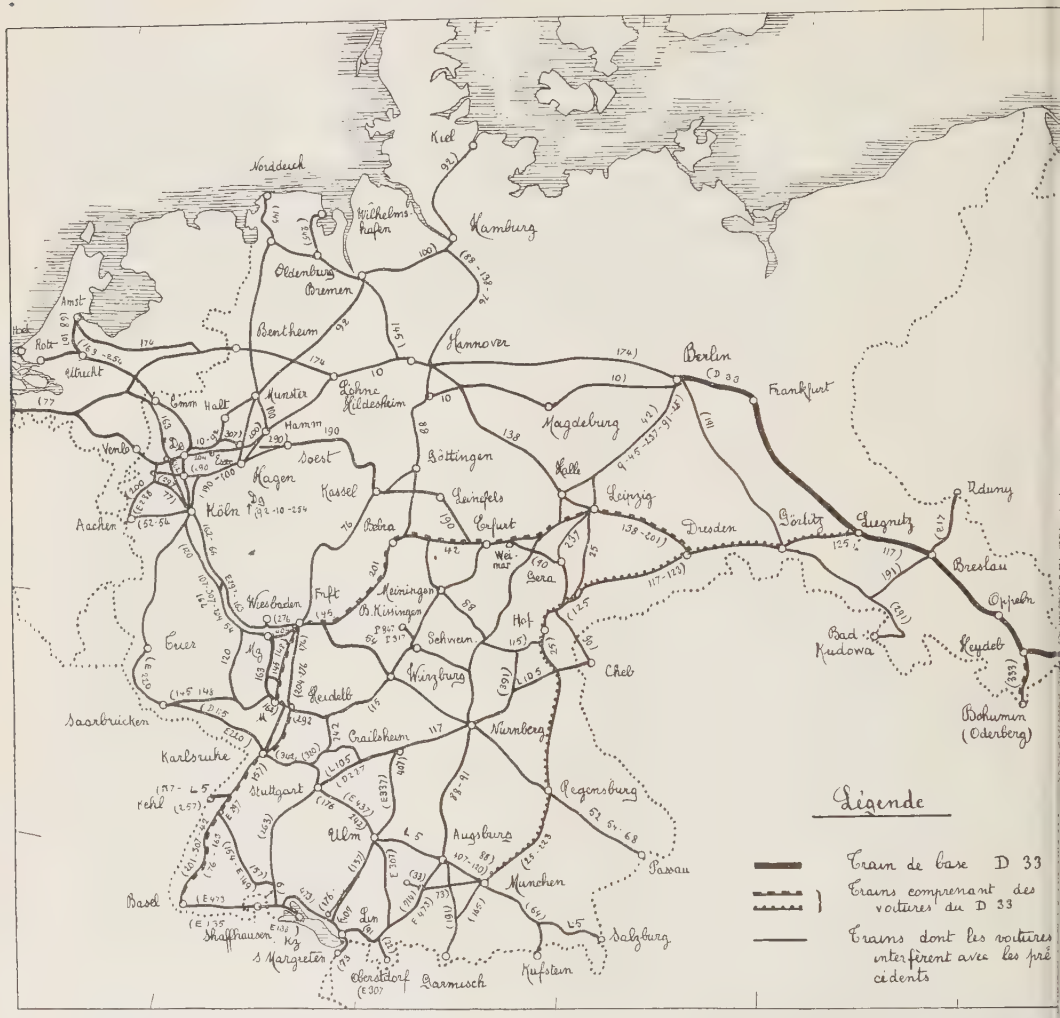


Fig. 383. — Route of *D* 33 train, and other trains whose runs interfere with the former.

These four fast trains in their turn follow routes of which the above are only sections, and during these journeys other through coaches are attached or detached. If all these through runs are taken into account, the mileage reaches the impressive figure of 25 218 train-km. (15 670 miles) in each direction, and 12 725 km. (7 907 miles) of line are run over by 56 different trains including 2 L, 43 *D* (1), 10 *E* (2), and 7 ordinary *P* (3) train

(1) *D* trains : 54, 64, 68, 73, 76, 77, 8[illegible] 90, 92, 100, 107, 115, 117, 120, 125, 137, 13[illegible] 145, 145 (a different train with the same num[illegible]ber), 148, 154, 157, 162, 163, 174, 176, 19[illegible] 191, 201, 204, 217, 233, 237, 242, 254, 26[illegible] 291, 307, 320, 333, 342, 404, 407.

(2) *E* trains : 135, 220, 238, 245, 270, 29[illegible] 310, 337, 397, 473.

(3) Ordinary *P* trains : 33, 257, 317, 34[illegible] 714, 2256, 3566.

Table 312*a*.

NOTEWORTHY GERMAN TRAIN RUNS RADIATING FROM BERLIN.

(Non-stop runs are shown in **heavy** type.)

Runs.	Distance. Km.	Distance. Miles.	Time of departure.	Time spent.	Number of stops.	Speed. Km./h.	Speed. M.p.h.	Trains.
n Stett.-Neustrelitz (Warne-nde)	100	62.1	8.30 a. m.	1.16	...	71.4	44.4	*D.* 111.
n Stett.-Pasewalk (Sassnitz)	103	64.0	8.50 p. m.	1.43	...	60.0	37.3	*D.* 13, Sweden.
n Stett.-Angermünde-Stettin.	135	83.9	8.16 a. m.	1.50	...	73.6	45.7	*D.* 21.
n Stett.-Angermünde-Stettin.	152	94.4	6.00 a. m.	2.45	4	55.3	34.4	Motor road 1.
n Stett.-Gesundhausen-Swi-münde.	201	124.9	3.17 p. m.	2.28	...	81.5	50.6	*E.* 33.
n (Stadt.) Schl.-Königsberg.	589	366.0	4.53 p. m.	6.45	5	87.2	54.2	*D.* 15.
rlin Schl.-Küstrin-Neustadt .	86	55.4	4.53 p. m.	0.52	...	99.2	61.6	*D.* 15.
strin-Neustadt-Landsberg. .	43	26.7	5.47 p. m.	0.28	...	92.1	57.2	*D.* 15.
ndsberg-Schneidemühl . . .	118	73.3	6.16 p. m.	1.09	...	102.5	63.7	*D.* 15.
neidemühl-Marienburg. . .	198	123.0	7.31 p. m.	2.28	...	80.4	50 0	*D.* 15.
rienburg-Elbing	29	18.0	10.07 p. m.	0 19	...	91.6	56.9	*D.* 15.
ing-Königsberg	116	72.1	10.26 p. m.	1.12	..	96.7	60.1	*D.* 15.
n (Stadt.) Schl.-Insterburg .	700	435.0	10.09 a. m.	11.19	...	61.7	38.3	*D.* 55.
rlin Schl.-Frankfort/Oder. .	82	51.0	R 8.53 a. m.	0.51	...	96.5	60.0	*D.* 34.
nkfort/O.-Neu Bentschen .	97	60.3	10.17 a. m.	1.13	...	80.0	49.7	*L.* 11, *Nord Express.*
erode-Allenstein	40	24.9	R 10.30 p. m.	0.28	...	85.7	53.3	*D.* 8.
enstein-Rothfliess	31	19.3	7.24 a. m.	0.21	...	88.6	55.1	*D.* 8.
rdauen-Insterburg	45	28.0	R 7.14 a. m.	0.30	...	90.0	55.9	*D.* 56.
n (Stadt) Schl.-Sagan-Lieg-z-Breslau	341	211.9	8.31 p. m.	2.39	...	128.7	79.5	*FDt* 45.
n (Stadt) Schl.-Sagan-Sorau-slau	348	216.2	R 6.08 a. m.	3.36	5	96.7	60 1	*D.* 34.
lin Schl.-Frankfort/Oder. .	81	50.3	8.35 p. m.	0.52	...	93.5	58.1	*D.* 39.
nkfort/O.-Güben.	48	29.8	R 8.20 a. m.	0.29	...	99.3	61.7	*D.* 34.
ben-Sommerfeld	27	16.8	R 8.02 a. m.	0.17	...	95.3	59.2	*D.* 34.
mmerfeld-Sorau	27	16.8	R 7.44 a. m.	0.17	...	95.3	59.2	*D.* 34.
au-Liegnitz.	75	46.6	R 6.49 a. m.	0.43	...	104.7	65.0	*D.* 34.
gnitz-Breslau	65	40.4	R 6.08 a. m.	0.39	...	100.0	62.1	*D.* 34.
n (Stadt) Breslau-Beuthen .	170	105.6	11.13 p. m.	1.39	3	103.0	64.0	*FDt* 45, diesel.
slau-Oppeln	82	51.0	11.13 p. m.	0.41	...	120.0	74.6	*FDt* 45, diesel.
slau-Brieg	42	26.1	2.05 p. m.	0.28	...	90.0	55.9	*D.* 31.
eg-Oppeln	40	24.9	2.34 p. m.	0.26	...	92.3	57.4	*D.* 31.
ppeln-Heydebreck	41	25.5	11.55 p. m.	0.21	...	117.1	72.8	*FDt* 45, diesel.
rdebreck-Gleiwitz	37	22.9	12.17 a. m.	0.19	...	116.8	72.6	*FDt* 45, diesel.
iwitz-Beuthen.	19	11.8	12.37 a. m.	0.15	...	76.0	47.2	*FDt* 45, diesel.
Görl.-Hirschberg-Breslau .	412	256.0	R 9.11 a. m.	5.53	...	70.0	43.5	*D.* 192.
lin-Schöneweide-Cottbus . .	108	67.1	R 10.32 p. m.	1.12	...	90.0	55.9	*E.* 196.
tbus-Görlitz	94	58.4	R 9.27 p. m.	1.02	...	91.0	56.5	*E.* 196.
litz-Greiffenberg	40	24.9	R 8.52 p. m.	0.28	...	85.7	53.2	*E.* 196, electric.
iffenberg-Hirschberg . . .	38	23.6	R 8.25 p. m.	0.26	...	95 4	59 3	*E.* 196, electric.
igszelt-Breslau	48	29.8	7.11 a. m	0.32	...	96.0	59 6	*E.* 198, electric.

TABLE 312*a* (*continued*).

RUNS.	Distance. Km.	Distance. Miles.	Time of departure.	Time spent.	Number of stops.	Speed. Km./h.	Speed. M.p.h.	Trains.
Berlin Anh.-Elsterwerda-Dresden-Neustadt	176	109.4	R 9.37 a. m.	1 35	...	111.0	69 0	*D.* 23, steam.
Berlin Anh.-Dobrilugk	103	64.0	1.45 p. m.	1.11	...	87.0	54.1	*D.* 64.
Berlin Anh.-Jüterborg-Falkenberg (Dresden)	112	69.6	R 1.56 p. m.	1.12	...	93.3	58.0	*D.* 63.
Berlin Anh.-Jüterborg	63	39.1	10.00 a. m.	0.42	...	90.1	56.0	*D.* 62.
Berlin-Falkenberg	112	69.6	11.16 a. m.	0.56	...	103 0	64.0	*D.* 63.
Falkenberg - Röderau - Dresden-Neustadt	76	47.2	11.16 a. m.	0.56	...	81 4	50.6	*D.* 62.
Berlin Anh. - Leipzig - Ingolstadt-Munich	686	426.3	5.06 p. m.	6.36	2	104.0	64.6	*FDt* 552, diesel
Berlin Anh. Wittenberge	95	59.0	8.26 a. m.	1 04	...	89 3	55.5	*D.* 140.
Berlin-Bitterfeld	132	82.0	3.47 p. m.	1.22	...	96.3	59.8	*D.* 126.
Berlin-Leipzig	165	102 5	5.06 p. m.	1 17	...	128 5	79.8	*FDt* 552, diesel
Leipzig-Plauen	122	75.8	9.56 a. m.	1 41	...	72 5	45.1	*D.* 322, Berchtes-
Hof-Ratisbon	179	111.2	12.50 p. m.	2.41	...	66.6	41.4	*D.* 322, Berchtes-
Ratisbon-Landshut-Munich	138	85.8	4.35 p. m.	1.44	...	81 2	50.4	*D.* 222, from D1
(Berlin Anh.) Leipzig-Nuremberg.	322	200.1	6.27 p. m.	3.25	...	94.2	58.5	*FDt* 552, diese
Nuremberg - Treuchtlingen - Munich	199	123.7	9 58 p. m.	1.44	...	113.8	70.7	*FDt* 552, diese
Berlin Anh. - Halle - Nuremberg-Augsburg-Munich	675	419.4	R 12.05 p. m.	7 43	3	87.4	54.3	*FD* 79.
Berlin Anh.-Halle	162	100.7	10.35 a. m.	1.33	...	104.5	64.9	*FD* 80.
Halle-Nuremberg	314	195.1	12.15 p. m.	4 00	...	78.5	48 8	*FD* 80.
Nuremberg-Augsburg	137	85.2	R 12.44 p. m.	1.24	...	97 8	60 8	*FD* 79, electric
Augsburg-Munich	62	38.5	R 12.05 p. m.	0.42	...	90.0	55.9	*FD* 79, electric
Berlin Anh.-Erfurt-Frankfort/Main	550	341 8	6.34 p. m.	5.03	4	108.9	67.7	*FDt* 572, diese
Leipzig-Weissenfels	40	24.9	7.45 p. m.	0 27	...	88.9	55.2	*FDt* 572, diese
Weissenfels-Erfurt	76	47.2	8.13 p. m.	0.45	...	101.3	63.0	*FDt* 572, diese
Erfurt-Frankfort/Main	269	167.1	9.00 p. m.	2.27	...	109 8	68.1	*FDt* 572, diese
(Berlin Anh.) Frankfort - Mannheim (Basle)	88	54.7	5.57 a. m.	1.00	...	88.0	54.7	*D.* 192.
Mannheim-Karlsruhe	61	37.9	3 12 p. m.	0.38	...	96.3	59.8	*FD* 102, *Rhein*
Karlsruhe—Baden-Baden	31	19.3	3.52 p. m.	0.21	...	88.6	55 1	*FD* 102, *Rhein*
Baden-Baden—Freiburg	103	64.0	4.14 p. m.	1.04	...	96.6	60.0	*FD* 102, *Rhein*
Freiburg-Basle (Reichsbahn)	61	37.9	5.19 p. m.	0.43	...	85.1	52.9	*FD* 102, *Rhein*
(Berlin Anh.) Erfurt-Schweinfurt (Stuttgart)	159	98.8	12 49 p. m.	2.26	...	65.2	40.5	*D.* 19.
Berlin Charlott. - Dessau - Halle-Würzburg-Stuttgart	468	290.8	11.26 a. m.	11 04	14	42.3	26.3	*D.* 16.
Berlin Charlottenb.-Dessau	112	69 6	11.26 a. m.	1 23	...	80.9	50.3	*D.* 16.
Berlin Potsd.-Magdeburg-Göttingen	323	200.7	8.00 a. m.	3 43	...	86 7	53.9	*D.* 178.
Berlin Potsd.-Potsdam	26	16.2	8.00 a. m.	0 16	...	97.5	60.6	*D.* 178.
Potsdam Magdeburg	116	72.1	8.17 a. m.	1.06	...	105.5	65.6	*D.* 178.
Magdeburg-Börssum	81	50.3	9.26 a. m.	0.56	...	87.3	54 2	*D.* 178.
Börssum-Seesen-Göttingen	100	62 1	12 26 a. m.	1.18	...	76.9	47.8	*D.* 92.

Table 312*a* (*continued*).

Runs.	Distance. Km.	Distance. Miles.	Time of departure.	Time spent.	Number of stops.	Speed. Km./h.	Speed. M.p.h	Trains.
erlin Potsd.) Goslar-Halberstadt (Saarbrücken)	50	31.0	3.54 a. m.	0.37	...	94.6	58.8	*D.* 179.
rlin (Stadt) Zool.-Hanover-Wuppertal-Cologne	551	342.4	7.22 p. m.	4.44	4	123.7	76.9	*FDt* 16/18.
Berlin Spandau-Rathenow	59	36.7	7.02 p. m.	0.36	...	98.3	61 1	*D.* 106.
Berlin Charlott.-Stendal	101	62 8	9.20 a. m.	1.09	...	87.8	54.6	*D.* 104.
Berlin Zool.-Hanover	254	157.8	7.22 p. m.	1.56	...	131.4	81.7	*FDt* 116, diesel.
	254	157.8	3 58 p. m.	2.33	...	99 6	61.9	*FD* 22.
Hanover-Hamm W.	177	110 0	R 8.44 a. m.	1.20	...	137.9	85.7	*FDt* 15, diesel.
	177	110.0	6.38 p. m.	1.45	...	101.2	62.9	*FD* 22.
Hamm W.-Hagen	49	30.4	R 8.09 a. m.	0.31	...	94.8	58.9	*FDt* 17, diesel.
Wuppertal-Cologne	48	29 8	R 7.19 a. m.	0 31	...	92.8	57.7	*FDt* 17, diesel.
rlin (Stadt) Zool.-Hanover-Duisburg-Cologne	579	36.0	7 22 p. m.	4 55	5	117.8	73 2	*FDt* 16, diesel.
Hamm-Dortmund	31	19 3	10.40 p. m.	0.17	...	109.4	68 0	*FDt* 16, diesel.
Dortmund-Essen	34	21.1	10.58 p. m.	0.22	...	92.8	57.7	*FDt* 16, diesel.
Essen-Düsseldorf	42	26.1	11.21 p. m.	0.29	...	86.8	53 9	*FDt* 16, diesel.
Düsseldorf-Cologne	40	24.9	11.51 p. m.	0.26	...	92.3	57.4	*FDt* 16, diesel.
erlin Stadt) Hanover-Osnabrück (Benthem)	132	82.0	R 12.11 p. m.	1.23	...	95.4	59.3	*FD* 111.
erlin Stadt) Stendal-Salzwedel (Bremen)	57	35.4	8.06 p. m.	0.37	...	92.4	57.4	*D.* 106, Wilhelmshav.
lin Lehrter Bf.-Hamburg (Altona)	287	178.3	6.15 p. m.	2.24	...	119 6	74.3	*FD* 24.
lin Lehrter Bf.-Hamburg (Altona)	287	178.3	11 00 a. m.	2.17	...	125 7	78.1	*FDt* 2, diesel.
Berlin-Spandau-Neustadt	64	39.8	8.45 a. m.	0.43	...	89.3	55.4	*D.* 64.
Berlin Lehrter Bf.-Neustadt	76	47 2	R 9.04 p. m.	0.57	...	80.0	49.7	*D.* 63, from Kiel.
Berlin Lehrter Bf.-Wittenberge	127	78.9	3.36 p m.	1.22	...	92.9	57.8	*D.* 8.

for working the coaches from one *D* train to another.

Amongst these *D* trains there are ten centered on Berlin (1) and owing to the exchange made of through coaches, some of them, for example *D* 91, run towards Berlin, whilst others start therefrom. It also occurs that the same line is run over by one, two or even three trains which all interfere directly or indirectly with the basic train *D* 33. The route followed by train *D* 33 from Berlin towards the extreme south east of Germany can in consequence affect the operation of a very considerable part of the railway system, covering all the southern States, from Saxony to Basle as well as the Rhineland, and via Westphalia to Hamburg, and back to Berlin.

In addition it should be borne in mind that there are extensions of these trains into Holland (Amsterdam-Rotterdam-Flushing), Switzerland and Italy (Gene-

(1) *D* trains : 9, 10, 25, 33, 42, 45, 91, 174, 191, 237.

TABLE 312*b*.

NOTEWORTHY RUNS OVER LINES NOT RADIATING FROM BERLIN.

(Non-stop runs are shown in **heavy** type.)

RUNS.	Distance. Km.	Distance. Miles	Time of departure.	Time spent.	Number of stops.	Speed. Km./h.	Speed. M.p.h.	Trains.
Breslau-Görlitz-Dresden	270	167.8	R 6.00 a. m.	3.24	5	79.4	49.3	*D.* 118, from Stu gart.
Liegnitz-Kohlfurt	71	44.1	6.41 a. m.	0.52	1	81.9	50.9	*D.* 118, from Stu gart.
Bautzen-Dresden-Neustadt	57	35.4	**8.25** a.m.	**0.41**	...	**83.4**	**51.8**	*D.* 118, from Stu gart.
(Breslau) Dresden-Plauen (Stuttgart)	177	110.0	R 6.03 p. m.	2.52	2	61.7	38.3	*D.* 118.
(Dresden) Leipzig-Halle (Magdbg.)	38	23.6	**8.47** a. m.	**0.26**	...	**87.4**	**54.3**	*D.* 172, to Colog electric.
Halle-Köthen	36	22.4	**11 02** a. m.	**0.23**	...	**93.9**	**58.3**	*D.* 144, to Colog electric.
Köthen-Magdeburg	50	31.1	R **11.00** a. m.	**0.32**	...	**90.9**	**56.5**	*D.* 183, from Wism
Magdeburg-Stendal	62	38.5	**7 30** p. m.	**0.42**	...	**88.6**	**55.1**	*D.* 84, to Hamburg
Stendal-Wittenberge	54	33.6	**9.28** a. m.	**0.38**	...	**85.2**	**52.9**	*D.* 160, to Hambu
(Dresden) Hanover-Verden (Bremen)	87	54.1	**5.46** p. m.	**0.57**	...	**91.6**	**56.9**	*D.* 132, Wesermün
Verden-Bremen	36	22.4	**6.44** p. m.	**0.26**	...	**83.1**	**51.6**	*D.* 132, Wesermün
Bremen-Wesermünde	62	38.5	**7.15** p. m.	**0 45**	...	**82.7**	**51.4**	*D.* 132, Wesermün
Hamburg-Lehrte (Frankfort)	165	102.5	R **6.19** a. m.	**1.52**	...	**88.4**	**54 9**	*D.* 191, from Basle
Hanover-Göttingen	108	67.1	R **4.24** a. m.	**1.21**	...	**80.0**	**49.7**	*D.* 191, from Basle
Hamburg-Essen-Cologne	472	293.3	7.51 p. m.	4.32	8	104.1	64.7	*FDt* 38.
Hamburg-Bremen	115	71.5	**7.51** p. m.	**0.58**	...	**119.0**	**73.9**	*FDt* 38.
Bremen-Osnabrück	122	75.8	R **9.33** a. m.	**1.02**	...	**118.1**	**73.4**	*FDt* 38.
Osnabrück-Münster	50	31.1	**9.54** p. m.	**0.27**	...	**111.1**	**69.0**	*FDt* 38.
Münster-Hamm	35	21.7	**10.22** p m.	**0 21**	...	**100.0**	**62.1**	*FDt* 38.
(Hamburg) Münster-Recklinghausen	57	35.4	**9.38** a. m.	**0.38**	...	**90 0**	**55.9**	*D.* 396, to Cologne
(Cologne) Münster-Rheine (Norddeich)	39	24 4	**2.36** p. m.	**0.29**	...	**80 7**	**50.2**	*D.* 47, from Munic
Rheine-Leer	114	70.8	**3.07** p. m.	**1.21**	...	**84 4**	**52.4**	*D.* 47, from Munic
Leer-Emden	27	16.8	**4.30** p. m.	**0.20**	...	**81.0**	**50.3**	*D.* 47, from Munic
Saarbrücken Treves-Cologne	268	166 5	7.12 a. m.	3 45	3	71.4	44.4	*E.* 151, Eiltriebwa
Merzig-Treves	49	30.4	**7.42** a. m.	**0.37**	...	**79.4**	**49.3**	*E.* 151, Eiltriebwa
Treves-Cologne	180	111 8	**8 21** a. m.	**2 36**	...	**69.3**	**43.1**	*E.* 151, Eiltriebwa
(Cologne) Duisburg - Oberhausen-Emmerich	69	42.9	**5.03** p. m.	**0.45**	...	**92.0**	**57.2**	*FD* 101, *Rheingold*
Oberhausen-Emmerich	61	37.9	**6.13** p. m.	**0.40**	...	**91.5**	**56.9**	*FD* 263 Munich-H land.
Cologne RB.-Wiesbaden-Frankfort.	227	141.0	R 2.10 a. m.	3.05	1	73 6	45.7	*L.* 51, Ostend-Vien Express.
Cologne LB - Coblence - Mayence-Frankfort	223	138.6	12.13 p. m.	2.49	3	79.1	49.2	*FD* 264, Hook of H land-Munich.
Cologne L.B.-Mayence	186	115.6	**12.05** p. m.	**2.06**	...	**88.6**	**55.1**	*FD* 102, *Rheingold*

Table 312*b* (*continued*).

Runs.	Distance. Km.	Distance. Miles.	Time of departure.	Time spent.	Number of stops.	Speed. Km./h.	Speed. M.p.h.	Trains.
ogne RB.-Coblence LB.-Mayen-e-Frankfort S.	220	136.7	1.38 a. m.	2.15	1	85.1	52.9	*L.* 52, *Ostend-Vienna Express.*
Cologne RB.-Neuwied-Coblence LB.	90	55.9	R 2.44 a. m.	1.15	...	72.0	44 7	*D.* 55, *Ostend-Vienna Express.*
Cologne RB.-Coblence LB.-Nied. RB.-Eltville	82	60.0	4.15 a. m.	1.07	...	73.4	45.6	*D.* 54.
Cologne RB.-Coblence LB. Nied. RB.-Frankfort	225	139 8	2 55 a. m.	3.24	5	66.7	41 4	*D.* 54.
Cologne-Niederlahnstein	96	59.7	12 16 p. m.	1.17	...	76.1	47.3	*D.* 164. Hook of Holland-Basle.
Cologne LB.-Cobl.-Niederl. RB.-Frankfort	229	142.3	3.07 p. m.	3.22	5	68.0	42.3	*D.* 68. Holland-Budapest.
Cologne RB.-Wiesbaden	185	115.0	R 2 54 a. m.	2.21	...	81 6	50 7	*L.* 51, *Ostend-Vienna Express.*
Cologne LB.-Mayence-Wiesbaden	196	121.8	11.40 p. m.	2.26	3	80.5	50.0	*D.* 308, Dortmund-Basle.
nkfort-Würzburg	136	84.5	R 12.30 p. m.	1.42	...	80.0	49 7	*FD* 263.
Würzburg-Nuremberg	102	63.4	R 10.35 p. m.	1.31	...	67.3	41.8	*L.* 51, *Ostend-Vienna Express.*
Nüremberg-Ratisbon	100	62.1	10.57 p. m.	1.19	...	76.0	47.2	*D.* 68.
Ratisbon-Passau	118	73.3	R 4.06 a. m.	1.23	...	84.1	52.3	*D.* 67.
ll-Munich-Salzburg	559	347.3	3.01 a. m.	7.28	3	74.8	46.5	*L.* 5, *Orient Express.*
Kehl-Karlsruhe	73	45.4	3.00 a. m.	0.58	...	77.4	48.1	*L.* 5, *Orient Express.*
Karlsruhe-Stuttgart	90	55.9	R 1.14 a. m.	1.20	...	67.5	41.9	*L.* 6, *Orient Express.*
tuttgart-Ulm	92	57.2	8.33 p. m.	1.02	...	89 0	55.3	*FDt* 723.
Ulm-Augsburg	86	53 4	R 7.34 a. m.	0.46	...	112 2	69.7	*FDt* 723.
ugsburg-Munich	62	38.5	R 7.00 a. m.	0.33	...	112.7	70.0	*FDt* 720.
tuttgart-Munich	221	137.3	R 10.10 p. m.	2.47	...	79.4	49.3	*L.* 6, *Orient Express.*
Munich-Freilassing	147	91.3	R 10.09 a. m.	1.46	...	86.4	53.7	*FDt* 722.
reilassing-Bad Reichenhall	15	9.3	8.50 p. m.	0.15	...	88.0	54.7	*FDt* 721.
ad Reichenhall-Berchtesgaden	19	11.8	9 05 p. m.	0.38	...	30.6	19.0	*FDt* 721.
unich-Salzburg	153	95.1	8.37 a. m.	1.52	...	81.9	50.9	*L.* 5, *Orient Express.*
t-Friedrichshafen	104	64.6	7.46 a. m.	1.32	...	67.7	42.1	1049 S.
nich-Garmisch	101	62.8	8.49 a. m.	1.22	...	83.9	52.1	*D.* 160
tich-Immenstadt (Lindau)	153	95.1	R 6.15 p. m.	2.00	...	76.5	47.5	*D.* 173.
tgart-Nuremberg (Eger)	190	118.1	9.59 p. m.	2.14	...	85 0	52.8	*FDt* 712.
uremberg-Eger	151	93 8	R 7.52 p. m.	2.04	...	73.0	45.4	*L.* 106, *Paris-Prague Express.*

va, Milan, Lucerne, Zurich and Chur), and even into Austria (Meran, Vienna, Graz and thence to Sissak and Budapest).

Forty-five *Mitropa* sleeping-car services are run in connection with these services in both directions, 22 of them in internal services (1) and 23 in international services (2) to Holland (18 coaches), Switzerland (1 sleeping-car), Austria (1 sleeping-car) and Turkey (2 sleeping-cars), as well as 8 sleeping-cars owned by the *International Sleeping-Car Company* (3); 6 buffet-cars and 37 restaurant-cars, 8 of which run into Holland, belonging to the Mitropa Company, are attached to these trains.

In addition to the important centres, these trains serve half a dozen watering places : Bad Kissingen, Wiesbaden, Baden-Baden, Oberstdorf, and Bad Kudowa.

And all this does not include connecting trains. The importance of the interconnections and the work involved in changing the timing of any one train in the series without revising all the others at the same time will consequently be appreciated. Finally it should be noted that if all the trains shown in figure 383 depend on the fast train *D* 33, the reverse also applies and any other of these interfering trains makes the same connections. The whole system shown therefore forms a complete unit.

The same work could be undertaken for a whole series of basic trains, but when they are revised the elements forming them vary and affect trains in connection with other basic trains than that under consideration.

LV-3. — **Internal services.** — To bring out the completeness of the services between the important German towns, we will consider in turn the *D* trains serving Berlin, those serving the secondary centres, and the interprovincial services. We will only deal here with the routes of the trains themselves, as given in the *Zugverzeichnis der Deutschen Reichsbahn* for the 1936 summer, and not those followed by coaches taken out en route, nor the connections made by other connecting trains.

A) **Trains radiating from Berlin** (fig. 384 and table 313). — In order to simplify this examination, we will mention the trains covering the longest distance over each of the lines of the radiating system. In the case of the international trains the distance necessarily ends at the frontier which is reached from Berlin at 17 places (4).

To these must be added two summer

(1) Berlin to Munich, Stuttgart, 2 to Garmisch, to Oberstdorf, Schaffhausen, 3 to Friedrichshafen, to Basle and 2 to Cologne;
from Cologne, Frankfort, Würzburg, Eger, Dresden to Hamburg;
from Eger, from Gera, 2 from Dortmund to Cologne;
from Basle to Dresden, and 2 from Munich to Dresden.

(2) Berlin, Leipzig, 2 from Würzburg, and from Basle to Amsterdam;
2 from Berlin, 2 from Leipzig, 2 from Munich and 2 from Hamburg to Flushing;
3 from Leipzig, from Munich and from Hamburg to Rotterdam;
from Berlin to The Hague;
from Chur to Berlin;
from Würzburg to Vienna;
2 from Berlin to Istambul.

(3) Paris to Carlsbad, Würzburg and Amsterdam-Bucharest, as well as 5 sleeping-cars from the « Orient » Express and « Paris-Prague » Express.

(4) *In the East :* Tilsitt, Neu Bentschen and Hindenburg;
In the South : Tetschen or Bodenbach and Eger, towards Czechoslovakia; Lindau, Schaffhausen and Basle towards Switzerland;
In the West : Kehl and Saarbrucken, towards France; Aix-la-Chapelle on the Belgian frontier; Emmerich and Cleves on the Dutch frontier;
In the North : Warnemünde and Sassnitz towards Scandinavia.

Fig. 384. — Routes of *D* trains serving Berlin.

resorts on the southern frontier (Bad Kudowa and Berchtesgaden), and some half dozen along the northern coasts (Norddeich, Wilhelmshaven, Westerland, Bad Doberan and Zinnowitz). There are also a few internal terminal stations such as Wuppertal, Wiesbaden, Kassel, Göttingen, Stuttgart, as well as Kiel and Stolp.

The ten trunk lines leaving Berlin divide up in turn, so that the *D* or *FD* trains run towards some thirty terminal stations, and in many cases some places are served by several alternative lines.

Breslau, for example, can be reached by three main lines, via Reppen-Glogau, via Sommerfeld-Sagan or via Görlitz (fig. 387).

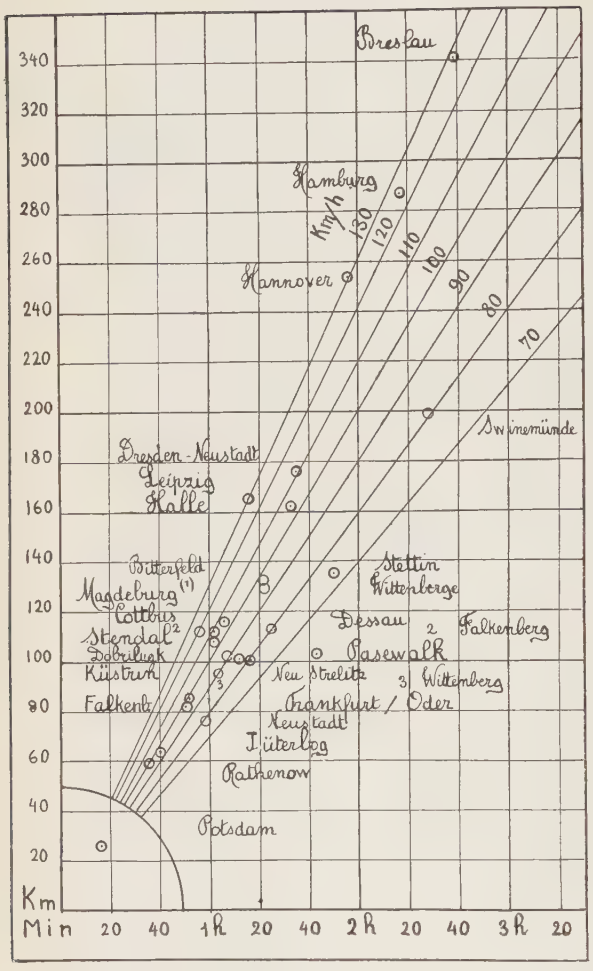


Fig. 385. — Diagram of non-stop runs from Berlin, and their speeds.

The central line itself gives alternative routes as the trains make a detour via (Sommerfeld) Sorau and Sagan, which increases the distance by 6.2 km. (3.3 miles), or a longer detour via Kohlfurt, which increases it by 31.7 km. (19.7 miles) (1). Some trains run over both these routes, which must be taken into account in determining the speed.

On the other hand, certain *D* trains using each of the outer lines continue beyond, either to Beuthen or Hindenburg, both on the frontier, or to Bad Kudowa. The same practice is followed in other parts of the country.

DRESDEN is also served by two lines over which fast trains are run; Munich also can be reached via Halle and Nuremberg or via Leipzig-Hof (fig. 388). As in the case of Breslau, there are variations in these routes also, some of the trains on the first of these two lines making a detour via Leipzig, which increases the distance by 10.6 km. (6.6 miles). In addition, between (Nuremberg) Treuchtlingen and Munich (fig. 389), some of the trains are sent round via Augsburg, and others via Ingolstadt, but this only increases their mileage by 1 km. (0.6 mile).

BERLIN-STUTTGART lines via Würzburg or via Nuremberg start a the end of each of the two Berlin-Munich lines.

Although, on principle, there are only two main lines to FRANKFORT, one via Kassel and the other via Erfurt, there are the usual alternative routes via Magdeburg or via Dessau to Güsten (186 km. = 115.6 miles from Berlin Potsd. and 166.5 km. = 103.5 miles from Berlin Zool.), whereas the alternative routes of the Erfurt line are either via Halle or Leipzig. It should be added that some of the trains on the latter end up with the former line at Göttingen, and others at Kassel, 432 km. (268.4 miles) from Berlin Potsd. instead of 380 km. (236.1 miles) from Berlin Zool.

---

(1) Sommerfeld-Sagan 33.2 km. (20.6 miles)
Sommerfeld-Liegnitz . . 39.4 km. (24.5 miles)
Sommerfeld-Sorau-Sagan 107 km. (66.5 miles)
Sommerfeld-Kohlfurt-Liegnitz . . . . . 138 km. (85.8 miles)

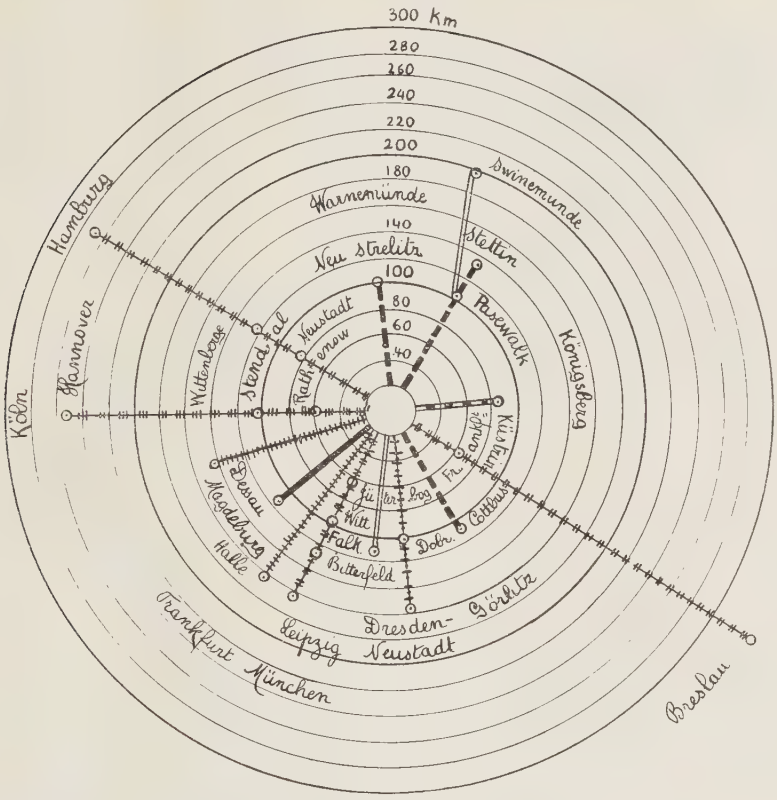


Fig. 386. — Cartogram of best speeds of non-stop trains serving Berlin.

We will consider later on the route llowed by the trains up the Rhine yond Frankfort.

Westphalia, of course, is served by the OLOGNE trains which use two main lines, a Hanover-Hamm or via Magdeburg-oslar, as well as the intermediate Mag-burg-Braunschweig line which joins up th the former at Lehrte or with the lat- before Paderborn. In Westphalia it- f all these trains follow one of the es we will deal with in examining this rticular district, which forms one of e special features of the German rail-y system.

The lines radiating towards the north do not call for any comment beyond the fact that it is possible to reach LÜBECK via Ratzeburg by using one of the *Lübeck-Büchen Railway Company*'s lines or via Bad Kleinen, and that the trains from STRALSUND also follow two alternative routes, via Neustrelitz or via Pasewalk, like the KÖNIGSBERG trains which can run via Schneidemühl or via Neu-Bentschen.

The trains from Berlin to DANZIG retrace their path after Dirschau, immediately beyond the Polish Corridor. This service has been completed by another consisting of railway services as far as Stettin and then a boat service to Zoppot which is close to the Free City.

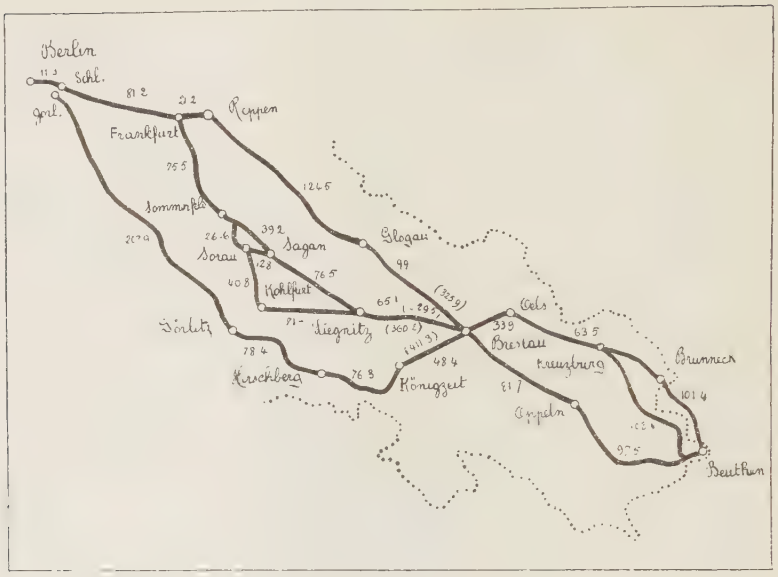


Fig. 387. — Alternative routes from Berlin to Breslau and Beuthen, and their distances.

The importance of the fast services between two towns from the passenger's point of view does not depend on the number of stops the train can mak between two places, but on the total tim taken for the journey, including th stops. Table 310 gives the time taken b the best train from Berlin without dedu ting the time for the stops, which a often many in number as well as length where the train has to be re-marshalle

To make this table more complete w have added the best train between Berl and some of the large towns served route, even when they are not the starti places of the long-distance train in que tion, for example in the case of Breslau Görlitz, Dresden, Leipzig, Nurembe Würzburg, Stuttgart, Frankfort, etc.

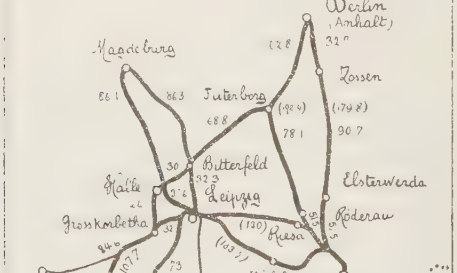


Fig. 388. — Alternatives routes from Berlin to Dresden and Saalfeld.

B) **The secondary Centres.** — The h torical constitution of the German Re has particularly favoured the devel ment of secondary centres, which h been further assisted by the use made through coaches. In no other coun

Table 313.

TRAIN SERVICES RADIATING FROM BERLIN (fig. 384).

Runs.		Distance.		Time of departure.	Time spent.	Number of stops.	Speed.		Train.
Destination.	via	Km.	Miles.				Km./h.	M. p. h.	
From Berlin Lehrter Bhf., to :									
ldeich	Bremen.	500	310.7	8.53 a. m.	8.19	15	60.0	37.3	*D.* 102, seaside.
emen	...	338	210.0	8.53 a. m.	4.48	7	70.4	43 7	*D.* 102, seaside.
emshaven . . .	Bremen.	344	213.8	6.48 p. m.	5.06	12	67.4	41.9	*D.* 106, seaside.
erland	Hamburg.	531	330.0	9.10 a m.	8.20	8	60 3	37.5	*D.* 14, seaside.
mburg	...	287	178.3	**11.00** a. m.	**2.17**	...	**125.7**	**78.1**	*FDt* 2, diesel.
		287	178 3	**6.15** p. m.	**2.24**	...	**119.6**	**74.5**	*FD* 23, steam.
. . . . .	Lübeck.	347	215 6	R 6.08 a. m.	4.53	9	77.4	48 1	*D.* 61.
From Berlin Stettiner Bhf., to :									
emünde . . .	Neustrelitz	233	144 8	8.45 a m.	3.06	4	75.2	46.7	*D.* 11.
Doberan . . .	Do.	236	146.7	8.30 a. m.	3 52	3	61.0	37.9	*D.* 111, watering pl.
itz Haf. . . .	Stralsund.	294	182.7	8.50 p. m.	4.51	5	60.6	37.7	*D.* 13, Sweden.
hagen	Ducherow.	238	147.9	3.11 p. m.	3.51	11	61.8	38.4	*E.* 141, watering pl.
ig	Swinemünde.	504	313.2	2.01 p. m.	18.00	4	28.0	17.4	*E.*129,train and boat.
ig	Stettin-Stolp.	503	312.6	8.40 a. m.	7.58	14	63.0	39.1	*D.* 23.
ttin	Angermünde.	135	83.9	**8.16** a. m.	**1.50**	...	**73.6**	**45.7**	*D.* 21.
inemünde . . .	Do.	201	124.9	**3.17** p. m.	**2.28**	...	**81.5**	**50.6**	*E.* 33.
: Berlin (Stadt.) Schles. Bhf., to :									
rburg	Elbing.	679	421.9	**4.53** p. m.	**8.25**	...	**78.7**	**48.9**	*D.* 15, Eydtkuhnen.
nigsberg . . .	Do.	589	366.0	4.53 p. m.	6.45	5	87 2	54.2	*D.* 15, Eydtkuhnen.
rburg	Allenstein.	700	435.0	10 09 a. m.	11.19		61.7	38.3	*D.* 55, via Poland.
hen	Glogau-Breslau.	505	313.8	9.42 a. m.	6.44	11	75.0	46.6	*D.* 31, Lemberg.
hen	Sagan-Breslau.	520	323.1	8.31 p. m.	4.21	4	119.6	74.3	*FDt* 45, diesel.
berg	Do.	522	324.4	R 5.30 a. m.	6.29	10	80.1	49.8	*D.* 30, from Vienna.
eslau	Sommerfeld-Sagan.	341	211.9	**8.31** p. m.	**2.39**	...	**128.7**	**80.0**	*FDt* 45, diesel.
eslau	Sorau-Sagan.	348	216 2	R 6.08 a. m.	3 36	5	96.7	60.1	*D.* 34.
eslau	Kohlfurt.	360	223.7	12.24 a. m.	4.21	8	72 5	45.1	*D.* 41.
rom Berlin Görlitzer Bhf., to :									
eslau	Hirschberg.	412	256.0	R 9.11 a. m.	5.53	14	70 0	43.5	*D.* 192.
Kudowa . . .	Waldenburg.	428	266.0	7.02 a. m.	6.42	9	64 0	39.8	*D* 193, watering pl.
rlitz	...	208	129.3	R 9.27 p. m.	2.27	2	84 9	52.8	*E.*196,to Hirschberg.

TABLE 313 (*continued*).

RUNS.		Distance.		Time of departure.	Time spent.	Number of stops.	Speed.		Train.
Destination.	via	Km.	Miles.				Km./h.	M. p. h.	
FROM BERLIN ANHALTER BHF., to :									
Dresden	Elsterwerda.	180	111.8	R 9.31 a.m.	1.41	1	106.8	66.4	*D.* 53, steam
Dresden	Jüterborg.	192	119.3	R 12.44 p.m.	2.19	3	82.9	51.5	*D.* 63, Prag
Bad Elster	Plauen.	322	200.1	10.17 a.m.	5.03	4	63.8	396.4	*D.* 186, M bad.
...Leipzig	...	165	102.5	R **6.26** p.m.	**1.48**	...	**91.7**	**57.0**	*D.* 185, M bad.
Berchtesgaden	Hof-Landshut.	716	444 9	8.00 a.m.	12.00	8	59.9	37.2	*D.* 322, wa pl., duplic
Munich	Do.	653	405.8	8.06 a.m.	9.38	7	68.5	425.7	*D.* 22.
Munich	Leipzig-Ingolstadt.	686	426 3	5.06 p.m.	6.36	2	104.0	64.6	*FDt* 552, di
Munich	Halle-Augsburg.	675	419.4	10.35 a.m.	7.53	3	85.5	53.1	*FD* 80.
...Nuremberg	Leipzig.	477	296.4	**5.06** p.m.	**4.48**	...	**101.5**	**63.1**	*FDt* 552, di
Lindau	Leipzig-Augsbourg.	816	507.0	8.06 a.m.	12.56	9	62.8	39.0	*D.* 180.
Stuttgart	Leipzig-Nuremberg.	691	429.4	10.23 p.m.	11.09	13	62.0	38.5	*D.* 238.
Stuttgart	Erfurt-Würzburg.	662	411.4	9.25 a.m.	9.23	5	70.6	43.9	*D.* 10, Zuri
...Würzburg	Erfurt.	472	293.3	9.25 a.m.	6.24	3	73.7	45.8	*D.* 10, Zuri
Schaffhausen	Erfurt-Stuttgart.	650	403.9	9.25 a.m.	13.17	7	49.8	30 9	*D.* 10, Zuri
Frankfort/M.	Leipzig-Erfurt.	550	341.8	6.24 p.m.	5.03	4	108.9	67.7	*FDt* 572, di
Basle Bad Rb.	Erfurt-Heidelberg.	885	549.9	10.14 p.m.	12.39	19	69.9	43.4	*D.* 2, Switze
...Karlsruhe	Do.	690	428.8	10.14 p.m.	9.41	...	71.4	44.4	*D.* 2, Switze
FROM BERLIN POTSDAMER BHF., to :									
Mannheim	Magdbg.-Börssum-Frankfort.	678	421.3	9.50 p.m.	8.59	8	75.3	46.8	*D.* 92.
...Frankfort	Magdbg.-Börssum-Kassel.	597	371.0	9.50 p.m.	7.28	6	78.2	48.6	*D.* 92.
...Frankfort	Güsten-Kassel.	579	359 8	8.55 a.m.	9.10	16	63.3	39.3	*D.* 28, Wie
...Frankfort	Magdeburg-Halberstadt-Kreiensen.	599	372.2	11.45 p.m.	8.30	8	70.5	43.8	*D.* 180.
Saarbrücken	Erfurt-Frankfort.	750	466.0	11.45 p.m.	11.47	23	63.6	39.5	*D.* 180.
Wiesbaden	Güsten-Kassel-Frankfort.	620	385.3	8.55 a.m.	11.54	17	52.1	32.4	*D.* 28.
Cologne	Goslar-Wuppertal.	579	359.8	1.47 p.m.	8.21	...	69.3	43.1	*D.* 32.
Aix-la-Chapelle	Goslar-Lehrte-Neuss.	672	417.6	12.50 p.m.	11.25	23	58.8	36.5	*D.* 30.
FROM BERLIN (STADTBAHN) ZOOL. GART., to:									
Cologne	Hamm-Wuppertal.	551	342.4	7.22 p.m.	4.44	4	116.4	72.3	*FDt* 16/18,
Cologne	Hamm-Essen.	579	359.8	7.22 p.m.	4.55	5	117.8	73.2	*FDt* 16.
Cologne	Dortmund-Oberhausen.	583	362.3	11.09 a.m.	7.49	11	74.4	46.2	*D.* 24.
Aix-la-Chapelle	Dortmund-	621	385.9	R 12.50 a.m.	7.42	3	80.7	50.1	*L* 11, No press.
Aix-la-Chapelle	Cologne.	622	386.5	8.39 a.m.	7.11	8	86.6	53.8	*FD* 26, Be
Bentheim	Dortmund-Krefeld. Hanover.	456	283.4	R 11.16 a.m.	5.00	2	91.2	56.7	*FD* 111, H

Fig. 389. — *D* trains serving a secondary centre : Munich.

are these characteristics so developed unless, though on a smaller scale, in England, and to some extent in Holland. As the importance of these centres is considerable, they are connected together by long transverse lines. For example, there are through trains linking up Hamburg not only with Berlin but also with Cologne, Frankfort, Basle, Stuttgart, Munich and Dresden, as well as with large towns in Holland, Switzerland and Scandinavia.

Through trains link up Cologne with Hamburg and Kiel, Norddeich, Basle, Stuttgart, Munich, Leipzig and Hof.

Many other large towns are in the same case : Frankfort, Basle, Stuttgart, Munich, Leipzig, Dresden, and Breslau, and what is perhaps still more remarkable, towns like Aix-la-Chapelle, Saarbrücken and Hof which are not very far from the frontiers.

These various places are the starting points of various services, but in most cases are also served by transit services which complete the former.

On the other hand, there are a certain number of secondary centres whose importance is due to the fact that various

TABLE 314.

TRAINS SERVING A SECONDARY CENTRE (MUNICH)

Fig. 389.

RUN		Distance		Time of departure	Time spent	Speed		Train.
Destination	Via	Km.	Miles.			Km./h.	M.p.h.	
Berlin Anhalt . .	Ratisbon-Hof-Leipzig.	653	405.8	12.42 p. m.	9.28	68.9	42.8	*D.* 23.
Do.	Augsburg-Nurember.-Leipzig.	686	426.3	5.06 p. m.	6.36	103.9	64.6	*FDt.*52, diesel.
Do.	Augsburg-Nuremberg-Halle.	675	419.4	12.05 p. m.	7.43	87.4	54.3	*FD.* 79.
Hamburg-Altona .	Augsburg-Würzburg.-Bebra Hanover.	826	513.3	5.16 p. m.	13.36	60 8	37.8	*D.* 87.
Norddeich . . .	Nuremberg-Frankfort-RB. Coblence-RB. Cologne-Dortmund.	1041	646.8	10.57 p. m.	18.58	54.9	34.1	*D.* 47, seaside.
Emmerich . . .	Frankfort-LB.-Cologne.	767	476.6	9.20 a. m.	9 48	78.3	48.7	*FD.* 263, Holla
Cologne	Stuttgart-Lar dau.	631	392.1	1.06 p. m.	10.45	55.3	34 4	*D.* 119.
Do.	Stuttgart-Mannheim.	646	401.4	8.56 a. m.	10.21	62.4	38.8	*D.* 369.
Do.	Stuttgart-Karlsruhe.	677	420.7	...	...	...	...	...
Do.	Würzburg-Frankfort LB.	635	394.6	9.20 a. m.	7.47	81.5	50.6	*FD.* 263.
Do.	Würzburg-Frankfort RB.	640	397.7	8.20 a. m.	10.20	61.8	38.4	*D.* 57.
Dortmund . . .	Würzburg-RB.-Cologne.	758	471.0	7.20 a. m.	12.27	61.8	38.4	*D.* 57.
Do. . . .	Eisenach-Kassel.	761	472.9	12.20 p. m.	10.36	71.8	44.6	*D.* 361.
Wupp.-Oberbarmen	Stuttgart-Mannheim RB.	732	454.9	8.56 a. m.	11.32	63.5	39.5	*D.* 369.
Kehl	Stuttgart.	406	252.3	10 10 p. m.	5.34	72.9	45.3	*L.*6 *Orient Ex*
Lindau	Buchloe-Immenstadt.	221	137.3	8.51 a. m.	3.14	68.4	42.5	*D.* 172, Zurich
Garmisch . . .	...	101	62.8	8.49 a. m.	1.22	73 9	45.9	*D.* 160, Innsbr
Kufstein . . .	Rosenheim.	99	61.5	7 55 a. m.	0.10	84.3	52.4	*D.* 67 do.
Berchtesgaden. .	Freilassing.	180	111.8	7.00 p. m.	2.43	66.3	41.2	*FDt.*721 water
Salzburg . . .	Freilassing.	154	95.7	8 37 a. m.	1.52	82.5	51.3	*L.*5 *Orient Ex*
Breslau	Ratisbon-Hof-Dresden.	814	505.8	R 4.19 p. m.	13.43	59.3	36.8	*D.* 128.

lines cross there, as at Hamm, Hanover, Leipzig and Karlsruhe.

The importance of these secondary centres can best be brought out by an actual example, such as that of Munich (fig. 389, table 314).

The salient points of these services are the following :

(a) There is sufficient traffic to justify the introduction of *FD* trains between Munich and Holland;

(b) D trains are run between Munich and certain other important centres over two alternative routes, according to the usual German practice. For example, Cologne can be reached either via Stuttgart or via Würzburg, and beyond that the trains can follow either bank of the Rhine;

(c) D trains are run not only between Munich and Cologne, but also through trains between Munich and other towns

Table 315.

MAIN INTERPROVINCIAL SERVICES (fig. 390).

Run.	Via.	Distance.		Time of departure.	Time spent.	Speed.		Train.
		Miles.	Km.			Km./h.	Miles/h.	
burg-Altona-Cologne.	Essen-Duisburg.	479	297 6	7.36 p. m.	4.47	100.0	62.1	*FDt* 37, diesel.
burg-Altona-Cologne.	Oberhausen-Duisburg.	457	284.0	11.28 a. m.	6.54	66.2	41.4	*D.* 96.
burg-Altona-Cologne.	Hamm-Wuppertal.	449	279 0	7.48 a. m.	6.34	68.4	42.5	*D.* 94.
burg-Altona-Dresden.	Magdeburg-Halle.	488	303.2	8.37 a. m.	7.18	69.1	42.9	*D.* 83.
burg-Stettin . . .	...	361	224.3	7.00 a. m.	5.07	70.5	43.8	*D.* 1 .
Rb.-Hamb.-Altona .	Mannheim-Fkft.-Kassel.	900	559.2	7.28 p. m.	13.04	68.9	42.8	*D.* 191.
Rb.-Hamb.-Altona .	Heidelberg-Fkft.-Bebra.	886	550.5	9.45 a. m.	13.21	66.4	41.3	*D.* 85.
Rb.-Emmerich . .	Mayence-Cologne.	643	402.7	R 10.15 a. m.	7.47	83.2	51.7	*FD* 102, Holland.
Rb.-Kleve . . .	Heidelberg-Mayence-Wiesbaden.	652	405.1	8.30 a. m.	10.11	64.2	39.9	*D.* 163, Holland.
Rb.-Dortmund . .	Mannheim-Mayence LB Oberhausen.	644	400.17	10.33 a. m.	11.12	57 5	35.7	*D.* 269.
Rb.-Dresden . .	Heidelberg - Darmstadt-Frankfort.	842	523.2	6 35 p. m.	13.37	61.7	38.3	*D.* 201.
-Chap.-Passau . .	Cologne-Frankfort.	755	469.1	12.34 a. m.	10.31	71.8	44.6	*L.* 520, Ostend-Vienna.
au-Kehl	Hof-Nuremberg-Stuttgart.	994	617.7	R 8.36 a. m.	16.06	61.8	38.4	*D.* 17.
Kehl	Nuremberg.	521	323.7	R 2.00 a. m.	11.52	43.9	27.3	*D.* 147.
Lindau	Immenstadt - Augsb. - Nuremberg.	482	299.5	9.38 a. m.	7.36	63.4	39.4	*D.* 179.
Salzburg	Munich.	559	347.3	3.01 a. m.	7.37	73.4	45.6	*L.* 5, Orient Express.
rücken-Frankfort .	Worms.	214	133.0	5.02 p. m.	3.23	63.2	39.3	*D.* 131.
fort-Oberhausen . .	Giessen-Hagen-Essen.	294	182.7	7.30 a. m.	5.39	52.0	32.3	*D.* 81.
g-M. Gladbach . .	Krefeld - Duisb. - Soest-Eisenach.	584	362.9	R 7.41 a. m.	9.33	61.1	38.0	*D.* 197.
g-Cologne . . .	Erfurt-Hagen-Wuppertal.	554	344.3	R 10.50 p. m.	9.19	59.4	36.9	*D.* 189.
en-Cologne . . .	Braunschweig-Hanover.	720	447.4	R 10.46 a. m.	10.14	70.4	43.7	*D.* 141.
en-Bentheim . . .	Halle - Magdeburg - Osnabrück.	593	368.5	8.27 p. m.	16.00	37.0	23.0	*D.* 178.
en-Wesermünde .	Leipzig-Goslar-Hild.	577	358.5	11.30 a. m.	8.38	66.8	41.5	*D.* 132.
en-Wismar . . .	Halle-Ludwigslust.	468	290.8	2.28 p. m.	7 23	63.4	39 4	*D.* 184.
münde-Stuttgart .	Kassel-Giessen-Darmstadt.	782	485.9	6.40 a. m.	12.37	61.9	38.5	*D.* 186.
-Ch.-Neu Bentschen.	Cologne-Dortmund-Berlin.	808	507.1	12.50 a. m.	10.55	74.0	46.0	*L.* 11, Nord-Express.
Jna	(Through carr. 198 and 398.)	30	18.6	8.22 p. m.	0.21	85.0	52.8	*D.* 298.
Fried. Mannheim .	...	10	6.2	8.31 a. m.	0.11	55.5	34 5	*D.* 302.
sing-Salzburg . .	...	7	4.3	7.47 a. m.	0.09	44.7	27.8	*D.* 326.

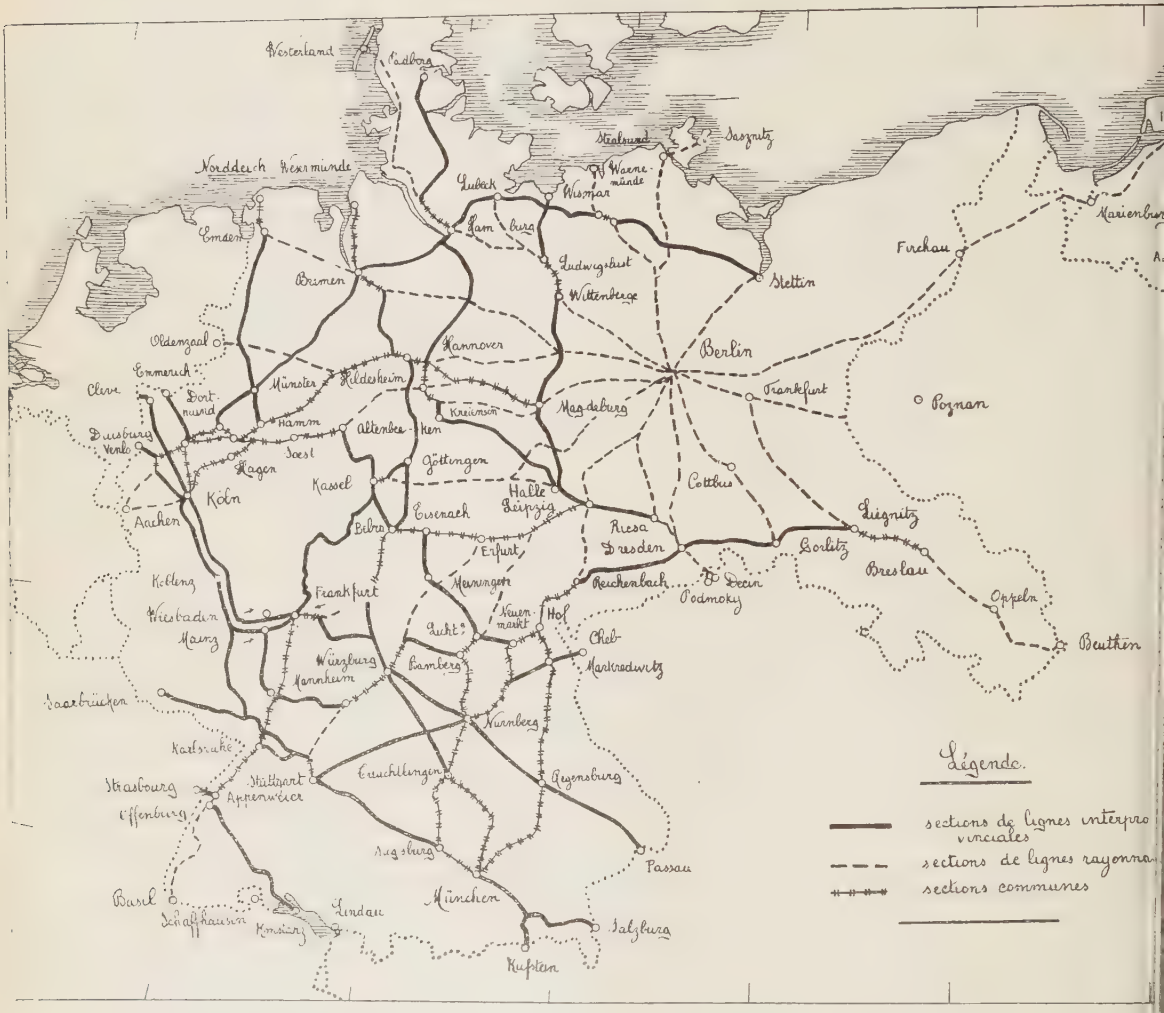


Fig. 390. — Interprovincial *D* trains.

Note. — ——— sections of interprovincial lines; — — — sections of radiating lines; ||—||—||—|| common sections.

in Westphalia : Wuppertal and Dortmund. In the case of Dortmund the trains follow two different routes, and reach that town either from the east or west (1);

(d) There are two important longitudinal transverse lines from Munich towards the north, which end up at Norddeich and at Hamburg-Altona, and a latitudinal line to Breslau;

(1) We mentioned a similar case, that of the « de luxe » trains from Berlin to the French Riviera, which is reached via Cannes as far as Ventimiglia, and via Ventimiglia as far as Cannes (see *Bulletin*, July 1934, pp. 686/262).

(e) The trains transiting between ance and Austria and those from Ber- to the Tyrol serve Munich en route, d leave Germany at Salzburg (interna- nal station) and at Kufstein;

(f) Finally, though the actual mileage Germany is small, the international rvices from Munich to Austria, Swit- rland and Italy are of considerable im- rtance.

From Munich to Innsbrück, *D* trains e run either via Kufstein (173 km. = 7.5 miles) or via Garmisch-Parten- rchen and Mittelwald (158 km. = 98.2 iles). Although shorter, the latter is e more difficult line, and the journey kes 3 h. 33 m. whereas via Kufstein only takes 2 h. 37 m.

C) **The interprovincial services** (fig. 0) are extremely well developed and ould be considered from two points of ew : that of the places linked up, and e way in which they are linked up, the trains running partly over lines which e not directly served from Berlin and rtly over lines radiating from the capi- . The chief interprovincial services e as follows :

Transverse lines from north to south :

Stettin-Küstrin (only 101 km. = 62.8 miles), which gives through services between the north, Breslau and the south-east;

Transverse lines through Berlin. — At the present time there are no through services:

Wismar-Magdeburg-Halle;

Flensburg-Hamburg and Hamburg-Munich via Bebra;

Norddeich-Giessen, towards Munich.

Vest to east transverse lines :

Hamburg-Stettin;

Cologne-Kassel-Halle-Sorau (Breslau);

Saarbrüchen-Würzburg-Hof and Hof-Dresden-Breslau.

Oblique lines :

Hamburg-Leipzig;

Wesermünde-Leipzig-Dresden;

Hamburg-Cologne.

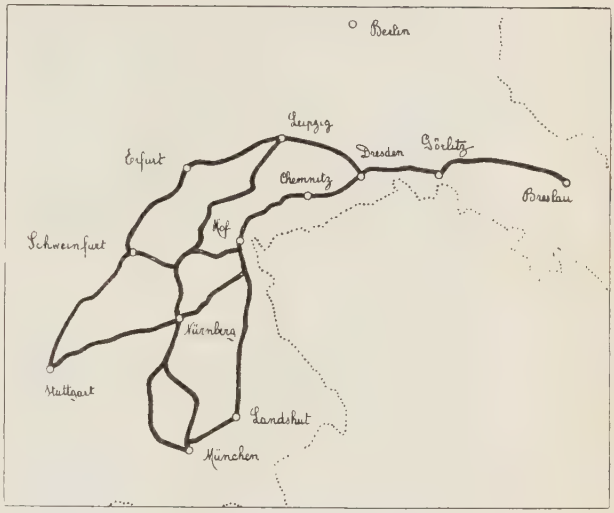


Fig. 391. — Breslau-Dresden branch and alternative lines to Stuttgart and Munich, run over by D trains.

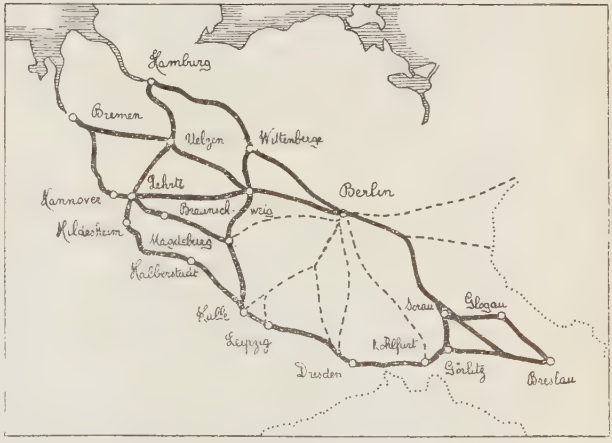


Fig. 392. — Through services from Breslau to Hamburg via Dresden or via Berlin.

International services :

a) Amsterdam and Ostend-Vienna, via Cologne, Frankfort, Nuremberg and Passau;

b) Strasbourg-Munich and Salzburg (from France to Austria).

The Breslau-Dresden latitudinal line and its branches (figs. 391 and 392),

forking off from Dresden to Leipzig and Dresden to Hof is of particular importance as it makes it possible to run through trains from Berlin via Dresden to Hamburg, Cologne and Leipzig, without calling at Berlin, as well as to Frankfort, Saarbrücken, Stuttgart and Munich via Hof, without running through Czechoslovakia.

The **Rhine** line has certain very special characteristics. In view of the density of the population along the river banks, two different companies built railways along it, one on the left bank, and one on the right. The services along the Rhine are also still further complicated by the simultaneous existence, due to the geographical situation of the river, of various economic factors.

Fast trains in various services run alongside the river during the whole or part only of their journey.

The services from one end to the other include those between Holland and Switzerland, from Emmerich or Cleves to Basle.

The partial services are more diverse, and naturally more complicated owing to the loop the river makes in the middle at Frankfort, and the bend in the opposite direction in the upper part (Basle-Frankfort) and lower part (Frankfort and Cologne). Each of these two large sections is followed by trains extending them to a greater or lesser degree beyond Frankfort. For example, the trains from Basle to Frankfort go on to Berlin or Hamburg (by two different routes in each case) and the services from (Holland or Belgium) Cologne to Frankfort are extended to the Tyrol and Salzkammergut via Nuremberg-Passau or Stuttgart and Munich.

Taking this route as a whole, there are three districts with very special railwa conditions.

a) THE BASLE-FRANKFORT SECTION (fi 393). — We have already stated th there is a railway on each side of the r ver. Between Basle, Strasbourg and Wi den (the present frontier) the railway c the left bank is now in foreign territor so the trains from Basle to Holland v Strasbourg have been diverted via Bru sels, thus giving rise to internation competition between the internation services on the two banks of the rive a subject we have already dealth wit

Fig. 393. — Lines in the Rhine valley, over by D trains, and lengths of the pr cipal sections.

etween Strasbourg and Appenweier in e south, and Mannheim and Frankfort the north, there are nonetheless three ngitudinal lines, to which a fourth in- rmediate line between Mannheim and arlsruhe must be added. They are all n over by *D* or *FD* trains from one end the other. In addition, between Neu- adt and Bingerbrück, there is a by-pass aking it possible to completely avoid e Frankfort bend and even Mayence nd Wiesbaden.

b) The Frankfort-Cologne Section ig. 393). — On this route the railway nes closely follow the river, as do the zechoslovak railways in the case of oth the Elbe banks, from the German ontier, at Tetschen or Bodenbach, to rague. However, some of the important wns on one side of the river are often rved by important trains from the op- osite bank. This is the case with Wies- den (terminal) on the right bank, ayence which faces it on the left bank (70 km. = 43.5 miles), and in particular Coblence (left bank) which is served by trains from both sides of the Rhine. For this purpose, in addition to the direct Niederlahnstein-Neuwied line (20.8 km. = 12.9 miles) on the right bank, two connecting lines have been built 4.6 km. (2.85 miles) up, and 14.5 km. (9 miles) down the river between Niederlahnstein (right bank) and Coblence (left bank), and between Coblence (left bank) and Neuwied (right bank). Some *D* trains which follow the left bank as far as Coblence continue by the right bank to Cologne, and inversely, whereas right-bank trains go on to Cologne by the left bank beyond Coblence. Finally some of the right-bank trains run into Coblence (left bank) using in turn the two connections over the river, so that except for this loop to take in Coblence, they keep to the right bank of the river the whole way. The distances by each of the routes followed by *D* trains are as shown in table 316 :

Table 316.

DISTANCES BETWEEN FRANKFORT AND COLOGNE.

Frankfort (L.B.)-Cologne	221.9 km. (137.9 miles)
Frankfort (R.B.)-Cologne	226.5 km. (140.7 miles)
Frankfort (LB.)-Coblence (R.B.)-Cologne . .	219.3 km. (136.3 miles)
Frankfort (R.B.)-Coblence (L.B.)-Cologne . .	227.4 km. (141.3 miles)
Frankfort (R.B.)-Coblence (R.B.)-Cologne . .	224.8 km. (139.7 miles)

c) Westphalian railway system (fig. 94). — The branch lines from Berlin nd from Cologne towards the north oss in Westphalia. The *D* trains from amm and Dortmund to Cologne follow ree different routes : the Essen-Duis- rg route, which may be shortened via agen and Wuppertal, or the northern ute via Gelsenkirchen, Oberhausen and uisburg, the respective distances being 8, 120 and 152 km. (92, 75 and 94.5 miles). In addition certain connecting lines, likewise run over by D trains, shorten or lengthen these distances. For example, from Essen to Düsseldorf (by the first of these routes) the distance is 43 km. (26.7 miles) via Duisburg, but there is a shorter (36-km. = 22.4 miles) route via Werden; and between Cologne and Düsseldorf there is a 45-km. (28-mile) long route via Neuss, whereas the direct line is 40 km. (25 miles) long.

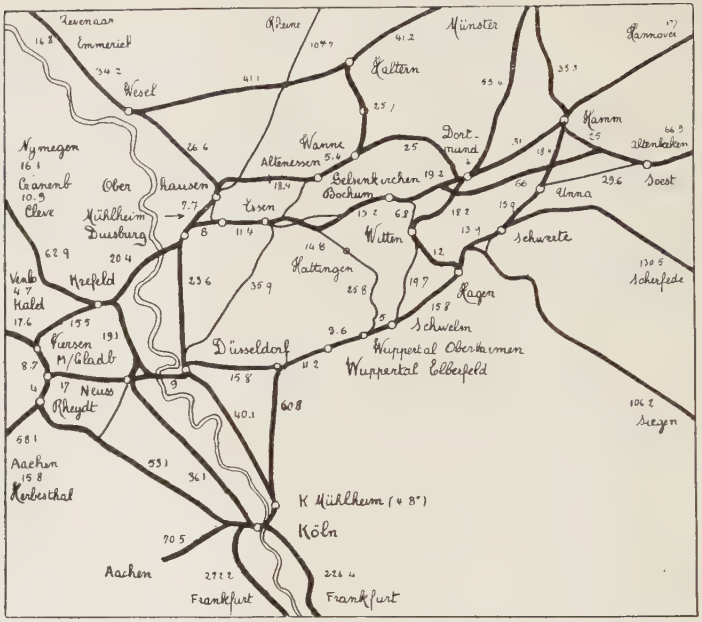


Fig. 394. — Westphalian lines run over by *D* trains, and lengths of the principal section.
The thin lines are run over by *E* trains only.

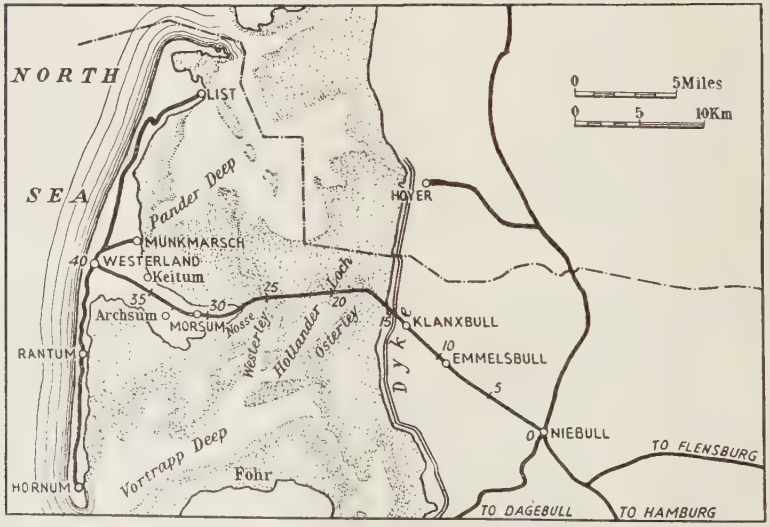


Fig. 395 (*). — Railway communications with the Sylt Island.

(*) Map taken from the *Railway Gazette*, London.

Certain places in this district are so important that in addition to the *D* trains serving Cologne, they are linked up directly with other important towns in Germany by other *D* trains. Such is the case with Dortmund, served via two different routes, by *D* trains from Munich and from Basle, from Essen (directly connected with Frankfort, Heidelberg and Munich), and from Scherfede (connected with Breslau).

On the other hand, the *D* or *FD* trains from Berlin and Hamm make use in Westphalia, towards Aix-la-Chapelle of 3 different routes which are all about the same length, i. e. respectively 191 km. (118.7 miles) via Duisburg, the same via Hagen and M./Gladbach and 192 km. (119.3 miles) via Wuppertal and Cologne.

LV-4. — **Services to seaside resorts** are highly developed; the tourist centres are served not only by through services and through coaches from Berlin, but also by trains from other important places; through trains link up Dresden and Stuttgart to Wesermünde, and Hanover and Munich to Norddeich, etc.

Westerland, in the Sylt Island on the western coast of Schleswig, is a rather special case (fig. 395). It was formerly reached by boat from Hamburg or by railway via Hoyer whence the Watten-

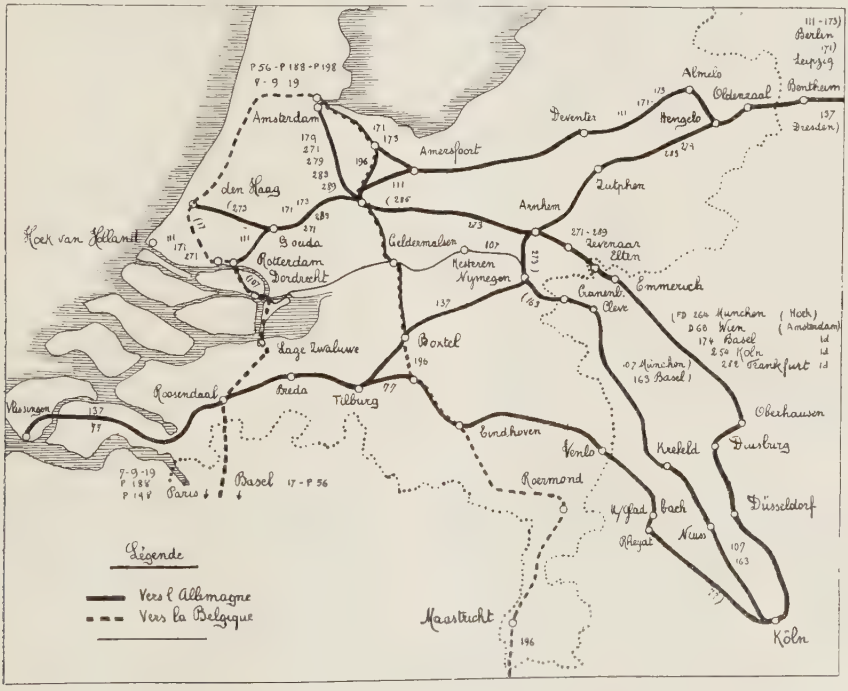


Fig. 396. — Routes in Holland of *D* trains coming from Germany or Belgium.

The numbers of the trains are given at the departure stations and along the routes.

Note: ——— Towards Germany; - - - - Towards Belgium.

meer strait was crossed to the island port of Munkmarsch. This crossing, which depended on the tide, took nearly three hours, and the whole journey from Hamburg took above eight hours in summer and twelve hours in winter.

As the Danish frontier now lies further south, the port of Hoyer is now in Denmark. To avoid foreign territory and at the same time speed up the journey, it was decided to link up the island of Sylt with the main south to north Schleswig line. To do this it was necessary to build a new branch line from Niebüll to Klanxbüll on the coast (opened in 1923), which meant a dike 11 km. (6.8 miles) long across the strait (1) and a branch line on the island from Morsum to Westerland. This new line of communication was opened on the 1st June, 1927.

The journey from Hamburg was shortened considerably and reduced to 288 km. (179 miles) which now take 4 hours 30 minutes. Some sections are run over at high speed; the overall speed over the 39 km. (24.2 miles) of the new line between Niebüll and Westerland is 92 km. (57.2 miles) an hour.

In actual fact it was the same idea which was put into practice in Holland on the Rosendaal-Flushing line (fig. 396) to link up the mainland with the Beveland Island across the eastern Scheldt (2).

When dealing with the English services to watering places we drew attention to the fact that the East Coast is served by a line running parallel to the coast some distance inland, with branch lines running perpendicularly from it to the sea, over which express trains from London are run. The lengths of similar branch lines to the coast, in Germany are as follows :

Branch.	Distance.		Time spent.	Speed.		Train.
	Km.	Miles.		Km./h.	M.p.h.	
Leer-Norddeich	62	38.5	1 h. 12	51.7	32.1	*D*
Oldenburg-Wilhemshaven . .	54	33.6	0 h. 45	72.0	44.7	*D*
Bremen-Bremerhaven-Wesermünde.	66	41.0	0 h. 52	76.2	47.3	*D*
Hamburg-Cuxhaven	103	64.0	1 h. 48	57.1	35.5	*E*
Niebüll-Westerland.	39	24.2	0 h. 45	52.0	32.4	*D*

LV-5. — **The international services to Holland are much more highly developed than those to Belgium.**

German *D* and *FD* trains are run through to Amsterdam, The Hague and Rotterdam, as well as to the ports of Flushing and the Hook of Holland, as the Berlin to London services go via Holland. Besides the following international boat trains run from Holland towards Germany or inversely (fig. 396) :

(a) from Flushing :

D.77/78, to Cologne, via Venlo-Kaldenkirchen;

(1) It cost 18 500 000 Rm.

(2) 750 m. (0.47 mile) of this dike runs across the eastern arm of the Scheldt, but the dike is extended on either side for some considerable distance across the polder bordering the river.

D.137/138, to Dresden, via Bentheim.

(b) From the Hook of Holland :

D.101/102, the « Rheingold » to Basel via Nymegen;

D.263/264, to Berlin, via Emmerich;

D.111/112, to Berlin, via Oldenzaal.

The other Germano-Dutch services are covered by the following trains :

D.171/172, from Amsterdam to Leipzig via Bentheim;

D.173/174, from Amsterdam to Berlin via Bentheim;

D.173/174, from Amsterdam to Basle via Emmerich;

D.281/282, from Amsterdam to Frankfort Emmerich;

D.254, from Amsterdam to Cologne via Emmerich;

D.68/67, from Amsterdam to Würzburg and Vienna via Emmerich;

D.164/163, from Amsterdam to Basle via Cleves;

D.107/108, from Rotterdam to Munich via Cleves;

D.132, The Hague-M./Gladbach, via Venlo.

Most of these trains include through coaches for each of the three conjugated cities : Amsterdam, The Hague and Rotterdam, such coaches being worked to destination by means of other connecting D trains.

Towards Belgium, with the exception of the « de luxe » trains, no train save the Vienna-Passau one, is from or for beyond Cologne.

Before the War, certain international trains ran from Flushing towards Germany using the *Noord Braband Spoorweg*'s line from Boxtel to Gennep and Wesel, which line has since been bought up by the Dutch and German Governments. The express trains have been diverted and sent round, from Tilburg, to 's Hertogenbosch and Nymegen.

An important change has been made in the Germano-Swiss services and their extensions beyond Switzerland, in that they were formerly worked along both banks of the Rhine, whereas they now are all run along the Baden bank. The distance from Basle to Frankfort is 328 km. (203.8 miles) via Schwetzingen-Darmstadt (1), 339 km. (210.6 miles) via Heidelberg-Darmstadt, and 338 km. (210 miles) via Mannheim. Along the left bank of the Rhine via Strasbourg-Landau, Worms and Biblis, the distance is 369 km. (229.3 miles).

The routing of certain « de luxe » trains was particularly affected by this change. Thus, the portion of the « Lloyd Riviera Express » which ran to the Riviera from Berlin via Ludwigshafen, Strasbourg, Mulhouse and Lyons is now run under the name of the « Riviera Express » on the right bank via Karlsruhe and Basle and thence by the Saint-Gothard line.

A similar change was made in Silesia. The Berlin-Breslau main line was via Oels, Kreuzburg, Czianu and reached Kattowitz via Lublinitz, the latter section being entirely in Poland. All the fast services have been diverted to the Breslau-Oppeln-Heydebreck parallel line, and beyond Oels the old line is now merely a regional one.

It will be enough to quote the particular case of the lines from Berlin in East Prussia, amongst which the Königsberg line which crosses Poland for 209 km. (129.9 miles) between Firchau and Tczew (Dirschau) and the Danzig territory for 17.5 km. (10.9 miles) between Tczew and Marienburg. The Allenstein line crosses Poland for 306 km. (190.1 miles) between Neu Bentschen and Deutsch Eylau.

(1) The route via Schwetzingen makes it possible to avoid Mannheim by diverting the trains from the central (Mannheim) line to the western (Darmstadt) line.

Table 317.

FRONTIER SECTIONS.

As in the rest of these series of articles, we have given the distances from the German frontier station. For information, the lengths of the frontier sections, between the German and foreign stations, run over by express trains, are given below.

Origin.	FRONTIER SECTION. RUN.	Distance. Km.	Distance. Miles.	Destination.
	To Holland :			
Bremen	Weener-Neuschanz (2)	10	6.2	Groningen, Leeuwarden.
Hanover	Bentheim-Oldenzaal (2)	15	9.3	Amersfoort, Amsterdam.
Münster	Gronau-Enschede (2)	9	5 6	Hengelo.
Cologne	Elten-Zevenaar (2)	9	5.6	Arnhem, Utrecht.
...	Emmerich-Zevenaar (2)	17	10.6	...
Cologne	Cranenburg-Nymegen (2)	16	9.9	Nymegen.
Cologne	Gennep-Hassum (2)	6	3.7	Boxtel (former *N. Brabant S. M.*) (3).
M./Gladbach	Dalheim-Vlodrop	...	...	Antwerp.
Cologne	Kaldenkirchen-Venlo (2)	5	3.1	Eindhoven.
Aix-la-Chap.	Aix-la-Chap.-Simpelved (2)	14	8.7	Maestricht.
	To Belgium :			
Cologne	Aix-la-Chap.-Herbesthal	16	9.9	Liége, Brussels.
	To France :			
Saarbrücken	Forbach (Beningen) (2)	(8)	(5)	Metz.
Frankfort	Hanweiler-Sarreguemines	2	1.2	Strasbourg (3).
Mayence	Winden-Kapsweyer (2)	10	6.2	Strasbourg (3).
Munich	Kehl (Strasbourg)	(8)	(5)	Paris.
	To Switzerland :			
Frankfort	Basle	...	...	Switzerland.
Stuttgart	Singen-Grottmadigen (2)	6	3.7	Zurich.
Basle	Erzingen-Schaffhausen (2)	19	11.8	...
	To Austria :			
Munich	Lindau-Bregenz	6	3.7	Arlberg, Chur.
Munich	Mittenwald (Scharnitz)	6	3.7	Innsbruck.
Munich	Kufstein	0	0	Innsbruck.
Munich	Salzburg	0	0	Trieste, Vienna.
Nuremberg	Passau	0	0	Vienna.
	To Czechoslovakia :			
Cheb (Eger)	Cheb	0	0	Nuremberg, Eger.
Leipzig	Vodtersreuth (Cheb) (2)	(14)	(8.7)	...
Dresden	Podmokly (Bodenbach) (2)	0	0	Prague.
Dresden	Decin (Tetschen) (2)	0	0	Prague.
Breslau	Mittelwalde (2)	0	0	Prague.
Breslau	Annaberg-Oderberg (2)	5	3.1	Vienna, Budapest.
	To Poland :			
Breslau	Hindenburg (Ruda Slaska)	(5)	(3.1)	Krakow.
Breslau	Beuthen (Chorzow)	(5)	(3.1)	Katowice.
Breslau	Militsch Zduny (2)	14	8.7	Warsaw.
Breslau	Trachenberg (Korsens)	(8)	(5)	Poznan.
Berlin	Schneidemühl-Miasteczkol	20	12.4	Bydgoszcz (Bromberg).
Berlin	Neu Bentschen-Zbasyn	6	3.7	Allenstein, Warsaw.
Berlin	Firchau-Chojnice	12	7.5	Königsberg.
...	Tczew (Dirschau)-Marienburg	17	10.6	Königsberg.
Stettin	Gross Boschpol-Strebielin	4	2 5	Danzig.
Allenstein	Deutsch Eylau-Jamielnik	8	5.0	Torun, Berlin.
Königsberg	Prostken-Grajewo	5	3.1	Warsaw.
	Towards Memel and Lithuania :			
Königsberg	Eydtkuhnen-Virbalis	2	1.2	Riga.
Insterburg	Tilsit-Papegiail	6	3.7	Memel, Libau.
	To Denmark :			
Hamburg	(Flensburg) Padborg	11	6.8	Fredericia.

The number (2) refers to the frontier sections operated by the *Reichsbahn* and the number (3) to thos on which D trains were run before the war, but have since been discontinued.

On certain frontier sections there is an international station. In this case, the end of the sectio where there is no customs office is given in brackets, as well as its length in kilometres (and miles

The Germano-Scandinavian services are worked either by ferryboat (with which we have already dealt) or via Jutland, which is crossed by trains from Berlin and from Hamburg.

The services between the latter town and the extreme north, at Frederikshavn, have recently been considerably improved as regards the Danish section, as beyond the frontier fast Diesel railcars with trailers have been introduced thereon.

Starting from Hamburg at 8.30 a.m., it is now possible to leave the frontier station of Flensburg at 11.43 a.m. instead of 11.50, and after a single stop at the Danish frontier (Padborg) which is left at 11.55, to reach Frederikshavn at 5.56 p. m., a saving of 3 h. 21 m. on the normal express train time. This journey includes the longest non-stop run in Denmark : the 220.6 km. (136.7 miles) between Flensburg and Aarhus, covered in 2 h. 56 m., i. e. at an overall speed of 75.2 km. (46.7 miles) an hour.

LV-6. — **The urban and suburban services** are particularly well developed in Berlin and Hamburg (fig 373) where local railway systems are worked side by with the main-line system.

There are two such local railways in

Table 318.

TYPICAL TRAIN SPEEDS OF THE BERLIN AND HAMBURG SUBURBAN SERVICES.

RUN.	Distance.		Time spent.	Number of stops.	Speed.		—
	Km.	Miles.			Km./h.	M. p. h.	
Berlin.							
Papestr. Stadtbahn Mahlsdorf	32.0	19.9	0.59	24	32.6	20.3	*Stadtbahn.*
(Papestrs.) Charlottenb.-Schl. Bhf. . .	11.4	7.1	0.22	9	31.1	19.3	Do.
Circle : Berlin Potsd.-Berlin Potsd.	43.1	26.8	1.18	29	33.2	20.6	Do.
Potsdam Stadtbahn Erkner	57.2	35.5	1.29	27	38.5	23.9	*Suburban tr.*
Berlin Görl.-Königswusterhausen	27.6	17.2	0.45	7	36.8	22 9	Do.
Berlin Stett. -Vorortbhf. Oranienburg	29.2	18.1	0.44	14	39.8	24.7	Do.
Hamburg.							
Blankensee Hambg. Hbf. Ohlsdorf	26 6	16.5	0.51	17	31.3	19 4	*Stadt- & Vorortbahn.*
Altona Hbf.-Hamburg Hbf.	6.4	4 0	0.13	3	29.5	18.3	Do.
Altona Alt. Kalt.-Neumünster Süd . . .	67.0	41.6	2.04	20	32 4	20.1	Company.
Hamburg-Schwarzenbeck .	37.4	23.2	0.59	10	38.0	23.6	*Reichsbahn.*

Berlin. The first, known as the *S-Bahn* includes the *Ringbahn*, a circle railway, and two transverse lines, the *Stadtbahn* from east to west, and a line from north to south, now under construction. These lines are completed by a series of suburban lines forming the *Vorort-Verkehr*, independent of the main-line system.

The lines used by the *Stadtbahn* trains for the most part lie beside the main lines which run right across Berlin.

Table 318 gives the speed of the *S-Bahn* trains including all the stops, the number of which is shown. For the sake of comparison we have added the same information for part of the journey between Charlottenburg and the Schlesischer Bahnhof.

The second is the metropolitan system (the *U-Bahn*).

As regards Hamburg, we have done the same and give information about the Altona to Hamburg Hbf. journey for which the position of the railways is similar to that in Berlin. As can be seen, in view of the great number of stops, the speeds are high.

The *Barmen-Elberfeld-Vohwinkel Suspended Ry.* is also a suburban railway. The speed, however, is slightly lower than on the preceding lines, the overall speed being 27 km. (16.8 miles) an hour, and the maximum speed 40 km. (25 miles) an hour. The line which climbs up 39.70 m. (129′) and is 13.3 km. (8.26 miles) long has 1 in 25 gradients and curves of 75 m. (243′) radius in the open track, and 9 and even 8 m. (29 1/2′ and 26 1/4′) at the ends (1).

CHAPTER LVI.

The sleeping-car and restaurant-car services.

LVI-1. — **Characteristics.** — The services differ from those on the rest of the Continent as the services of the *International Sleeping-Car Company* and those of other German Companies, only one of which now exists, the *Mitteleuropäische Schlafwagen- und Speisewagen-Gesellschaft (Mitropa)*, are worked side by side.

LVI-2. — **The Mitropa services**, like those of the *International Sleeping-Car Company*, include :

(a) important day or night express services;

(b) isolated saloon-car (Pullman type), sleeping-car or restaurant-car services;

(c) services for metre-gauge lines.

(a) **The Mitropa trains** (fig. 397). — Outside Germany the trains operated by this Company (« de luxe » trains, saloon-car trains and sleeping-car trains) are little known.

Two « de luxe » trains, which ran during the years of prosperitiy, have now been discontinued.

(1) The trains usually consist of 2 or 3 coaches, 5 at the most, carrying 75 passengers. As they weigh 12.5 tons, the tare weight per seat is 167 kgr. (359 lb.). The leading dimensions are :

Length	11.45 m.	(37′ 7″).
Width	2.10 m.	(6′ 11″).
Height	2.705 m.	(8′ 10 1/2″).
Distance between bogie centres	8.00 m.	(26′ 3″).
Bogie wheelbase	1.10 m.	(3′ 7 5/16″) (1900 type).
	1.30 m.	(4′ 3″) (1903 type).
Diameter of wheels	0.90 m.	(2′ 11 1/2″) (1900 type).
	0.75 m.	(2′ 5 1/2″) (1903 type).

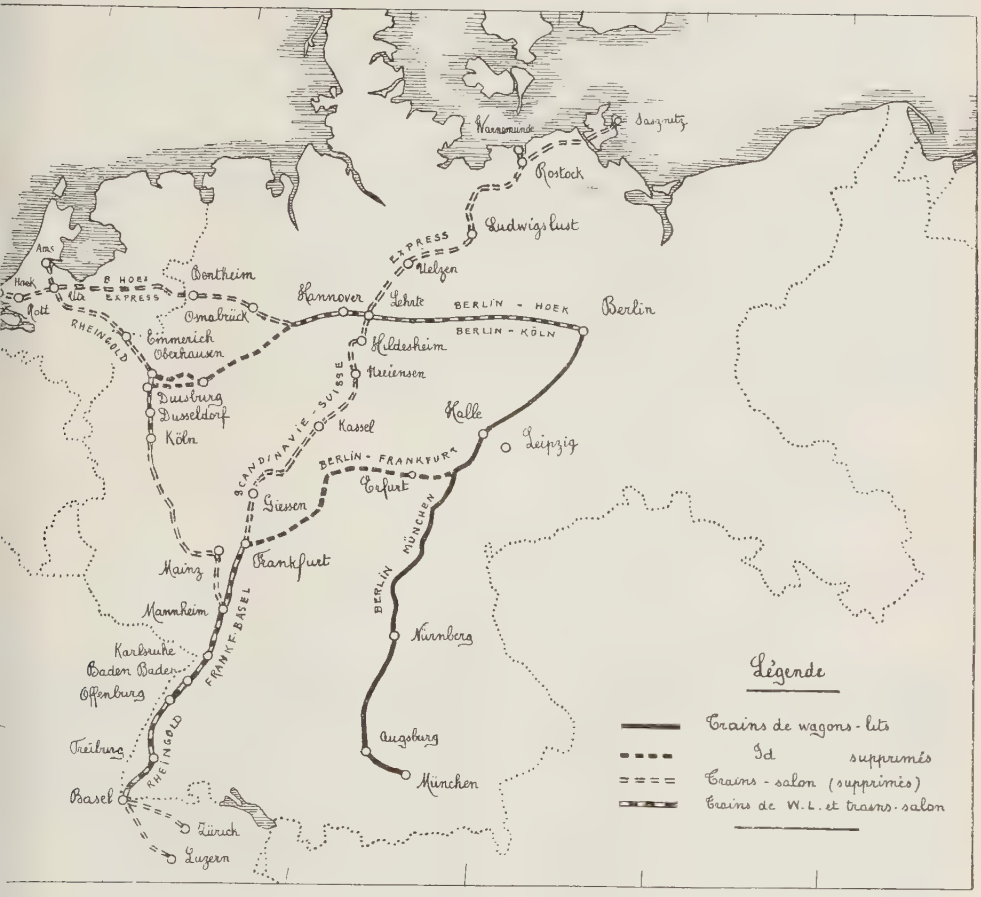


Fig. 397. — *Mitropa* « de luxe » trains.

Explanation:

Sleeping-car trains.
Discontinued sleeping-car trains.
Drawing-room car trains (discontinued).
Sleeping-car and saloon-car trains.

The Berlin-Hook of Holland Express (*L* 112/111) via Bentheim, introduced on the 2nd December 1922, was a day train connecting with the English services, but after some years it was converted into a fast train (*FD* 112/111) with two classes, in which a few saloon-cars were retained, to Amsterdam and the Hook. These in turn were discontinued in 1935.

The Scandinavia-Switzerland Express (*L* 92/91) picked up at Rostock coaches bringing passengers from the Danish ferryboat service from Warnemünde and Swedish ferryboat service from Sassnitz, and ran to Basle via Kassel and Frankfort.

The day train, the Rheingold (*FD* 102/101), which ran for the first time on the 15th May 1928, and became famous, formerly was composed exclusively

of drawing-room cars of the Pullman type (fig. 398). This train, made up of magnificent stock, linked up Amsterdam and the Hook of Holland (the junction being at Utrecht) with Basle via the right bank of the Rhine, following the same route as the former « Amsterdam-Switzerland Express » of the *International Sleeping-Car Company*. Mention has already been made of this Company's rival train the « Edelweiss » which linked up the same places but ran along the left bank of the Rhine.

The « Rheingold » which at the beginning was composed of 6 to 8 drawing-room cars weighing, including a brake van, 440 to 500 tons, like its rival the « Edelweiss », has decreased in importance. Formerly the only *FFD* class train since the 15th May 1936, when ordinary 1st and 2nd class coaches were added to it, it has become an ordinary *FD* train.

The comparative distances run by the « Rheingold » and the « Edelweiss » were given earlier on. Since then, they have both been speeded up and the runs are now as follows :

TABLE 319

THE « RHEINGOLD » AND THE « EDELWEISS » DURING THE 1936 SUMMER.
(The number of intermediate stops is shown in *italics*.)

RUN.	Rheingold.				Edelweiss.			
	Km.	Miles.	Outward.	Return.	Km.	Miles.	Outward.	Return.
Amsterdam-Basle *(Reichsbahn)* . .	777	482.8	10.30 *(13)*	10.35 *(12)*	...	...	...	...
Amsterdam-Basle *(Sw. Fed. R.)* . .	781	485.3	10 47 *(14)*	10.47 *(13)*	817	507.7	10.14 *(11)*	10.23 *(12)*
Hook of Holland-Basle.	826	513.3	11.24 *(14)*	11.42 *(13)*	...	...	...	...

The BALKANZUG was a famous train, though it was only short-lived. Introduced during the War to link up Germany with the Balkans, from whence it was to continue by the *Bagdad Ry.*, it necessarily ran at the reduced speed of all trains in that period. It was not a « de luxe » train.

Sleeping-car trains. — A certain number of all-sleeping-car trains (fig. 399) have been run between Berlin and some of the great provincial towns : Cologne, Frankfort, Munich and Basle, as well as between Frankfort and Basle. The two first trains, from Berlin to Frankfort and Cologne, were introduced by the *Reichsbahn* and all the others by the *Mitropa*. Only the Berlin-Munich train is still running.

The « Berlin-Basle » was divided up at Basel, the sleeping cars continuing to Geneva, Interlaken, Zurich and Chur. As the traffic was insufficient, ordinary coaches were added, so that it is now a heavy train usually consisting of 5 sleeping-cars (one Amsterdam-Basle), 5 ordinary coaches, a restaurant-car, a brake van and a mail van, so that there are at least 13 coaches.

Isolated services. — In 1933, there ere 131 sleeping-car runs, 51 of which international services, and 104 internal restaurant-car services. In 1936 these services were as shown in table 320 hereafter.

Table 320.

THE MITROPA SERVICES.

(Services reckoned in one direction only.)

Class of coaches.	Number of international services.		Total number of services.			Distance covered, km. *(miles)*	
	Radiating.	Transverse.	Radiating.	Transverse.	Total.	in Germany.	outside Germany.
Sleeping cars	13	16	44	34	78	13 097 *(8 138)*	3 305 *(2 053.7)*
Restaurant cars . . .	3 (1)	10 (2)	67	85	205	17 896 (3) *(11 121)*	1 133 *(704)*
Buffet cars	0	0	13	40			
Drawing-room cars . .	0	1	0	1	1	652 *(405.1)*	354 *(220)*

(1) To Karlovy Vary, Marianské Lazné and Hook of Holland.
(2) To Lucerne, Zurich, Arth-Goldau, and also Rotterdam, Hook of Holland, Flushing, and 4 to Amsterdam.

Fig. 398. — Inside view of a *Mitropa* drawing-room car.

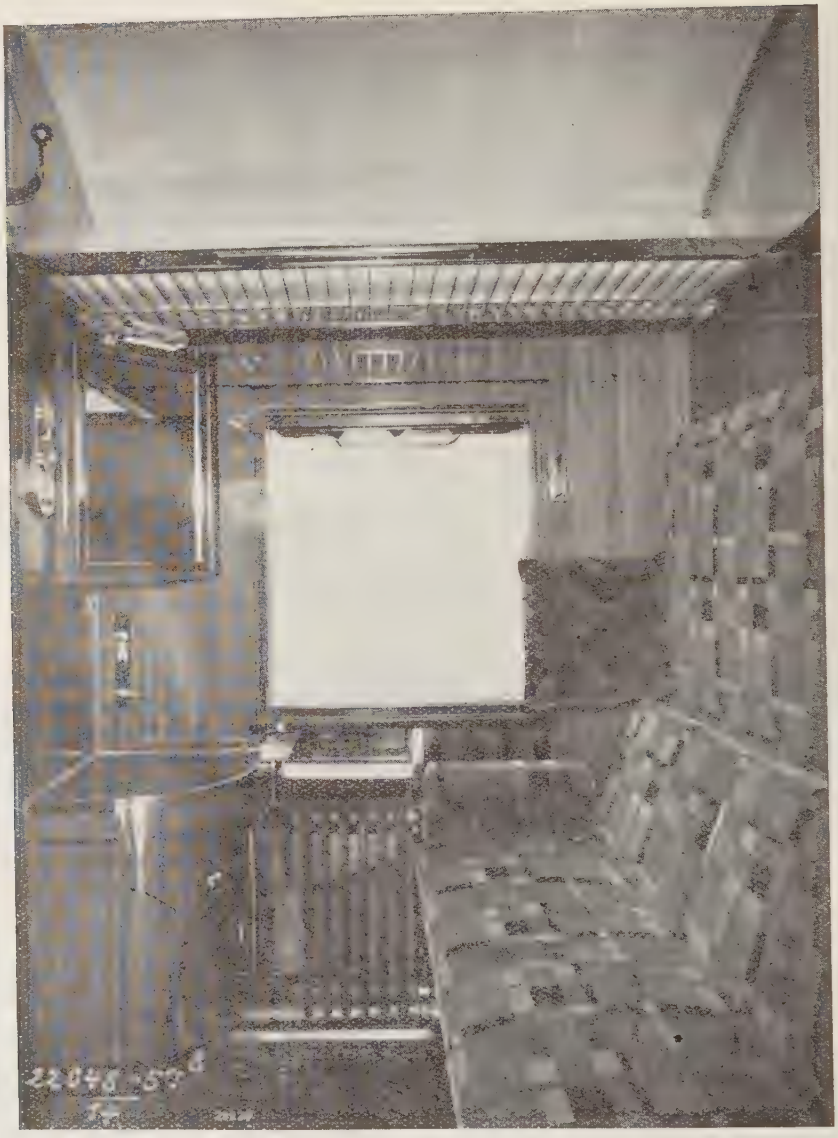


Fig. 399. — Interior of a *Mitropa* sleeping-car compartment.

One characteristic of the German railway system which is reflected in the *Mitropa* sleeping-car services (fig 401) is the importance of the secondary centres as starting places. For example :

9 sleeping-car services start from Alto Hamburg;

4 sleeping-car services start from Hambu and 1 in transit;

9 sleeping-car services start from Colog and 10 transit services;

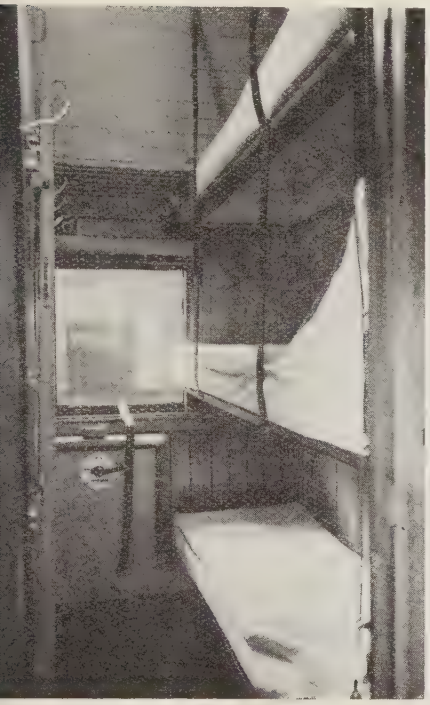


Fig. 400. — Interior of 3rd-class *Mitropa* compartment.

eping-car services start from Frankfort, and 7 transit services;

eeping-car services start from Munich, and 8 transit services.

ıe *Mitropa* has introduced an excep-ılly complete network of sleeping-car ces throughout Germany, even to the outlying parts (frontier stations or s) when the Mitropa is not allowed further, and it even penetrates into gn territory when permitted. It runs Scandinavia via Sassnitz, Warne-le and Padborg; into Holland via erich and Venlo; into Switzerland Basle, Lindau and St. Margarethen; into Austria via Salzburg and Pas-

e internal services end at Wester-land in the north, at Aix-la-Chapelle and Saarbrucken (for Paris) in the west; at the watering or holiday resorts of Friedrichshavn, Oberstdorf, Garmisch-Partenkirchen and Berchtesgaden in the south; at the frontier station of Beuthen (for Krakow) in the east; at Tilsit (for Riga) and the frontier station of Eydtkuhnen (for Kovno) in East Prussia.

In order to adhere to the operating practice of giving through day or night services between important towns, 3, 4 or even 5 sleeping-cars are often included in one train over the whole or part of the journey.

For example :

The Berlin-Basle *D* 42 and *D* 44 trains include 5 sleeping cars from Berlin for Geneva, Lugano, Basle and Chur, and from Frankfort an Amsterdam-Basle sleeping-car.

The *D* 137/*D* 138 Flushing-Dresden boat train includes :

3 sleeping-cars from Flushing and Bentheim for Leipzig, Hamburg, and Berlin;

1 Amsterdam-Bentheim-Leipzig sleeping-car;

1 Cologne-Dresden sleeping-car only.

The *D* 173/*D* 174 Amsterdam-Berlin train :

3 sleeping-cars to Bentheim and Berlin, from Amsterdam, The Hague and Flushing;

1 sleeping-car from Amsterdam to Hengelo and Leipzig;

1 Rotterdam-Bentheim-Hamburg sleeping-car.

The *D* 191/*D* 192 Basle-Hamburg-Altona train :

3 sleeping-cars from Basle to Altona, Bremen and Berlin;

1 Mannheim-Berlin sleeping-car;

1 Paris-Altona-Copenhagen sleeping-car of the *International Sleeping-Car Co.*

Train *D* 7/*D* 8 :

3 sleeping-cars from Berlin to Danzig, Allenstein and Eydtkuhnen;

1 Berlin-Riga sleeping-car of the *International Sleeping-Car Co.*

It should be noted that the examples quoted above include as many transverse lines as lines radiating from Berlin.

The longest of the national services is that between Berlin Potsdam and Basle

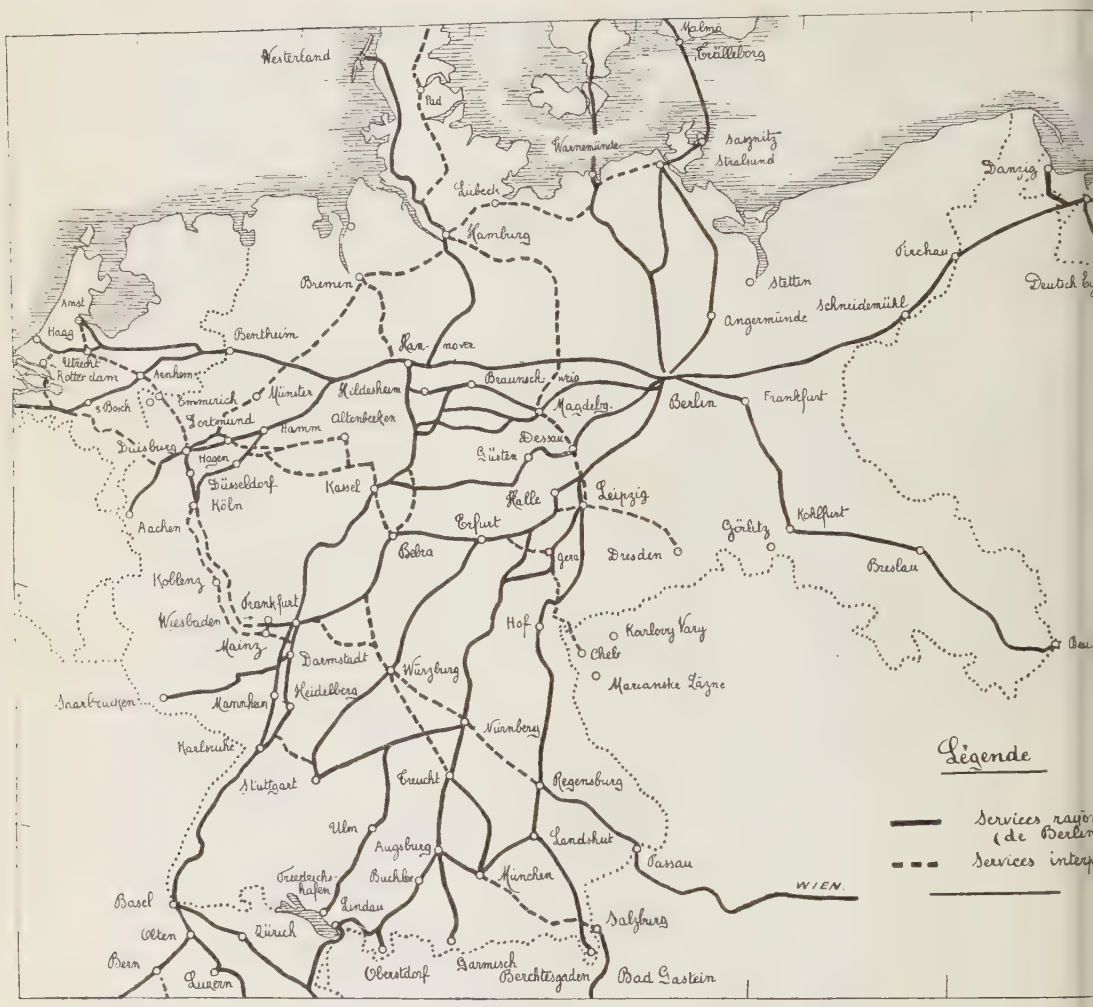


Fig. 401. — Map of the *Mitropa* sleeping-car services.

Explanation:

Services radiating from Berlin. — Interprovincial services.

via Magdeburg, 935 km. (581 miles) long, the return journey being worked via Worms and Frankfort; it takes 15 h. 55 m. (887 km. = 551 miles by this route). The shortest service is that between Berlin Lehrte and Hamburg, 294 km. (182.7 miles) in 6 hours.

Certain services have been extended recently. The increased speed of most of the trains has resulted in shortening th journey times of the sleeping-car serv ces, so that the *Mitropa* decided to e tend some of these services. The servi between Vienna and Nuremberg has bee extended as far as Würzburg, so that th through passengers have a better nigh This example might be copied with a vantage on certain other lines.

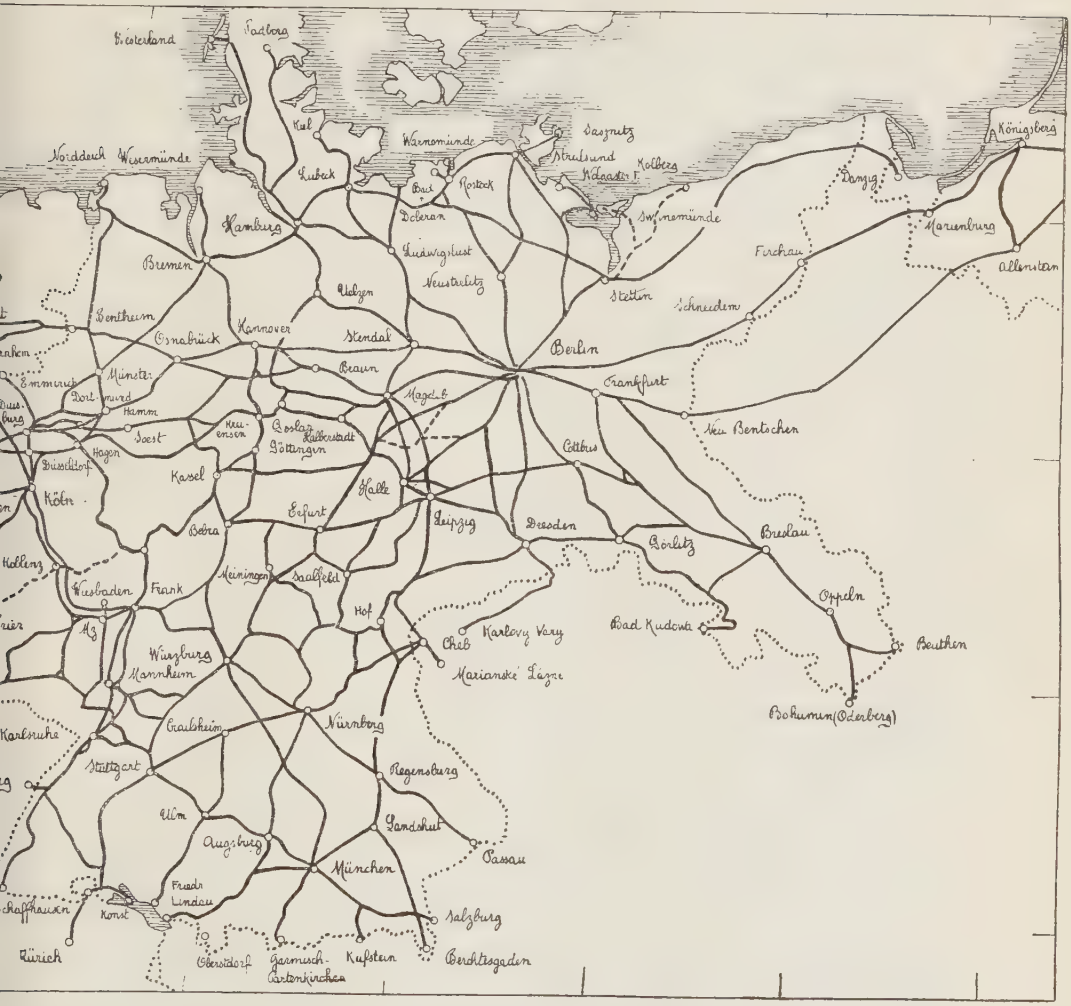


Fig. 402. — Map of the *Mitropa* restaurant-car services.

he supplement for the use of sleep-cars is charged for the night regard- of the distance (figs. 399 and 400). 1st-cass supplement is 25 Rm., the -class half this amount, i. e. 12.5 Rm., the 3rd-class one quarter, i. e. 6.25 , without linen in the 3rd-class (or n. with linen).

The Mitropa international services. — The *Mitropa* works sleeping-car services between Germany, on the one hand and Denmark, Sweden, Austria, Switzerland and Holland, as well as through services between Holland and Switzerland via Germany. The most developed are the Germano-Dutch services, which are 14

TABLE 321.

INTERNATIONAL SLEEPING-CAR SERVICES WORKED BY THE MITROPA.

Number of services in each direction from :	Holland.	Switzerland.	Denmark.	Sweden.	Austria.
Berlin	3	3	2	1	2
Hamburg	3	...	1	1	...
Munich	1	...	...	...	1
Würzburg	1	...	...	...	1
Basle	2	1	...	...	...
Leipzig	2	...	...	...	...
Transit	2		...	...	...

The lengths of the services concerned in each country are as follows :

Holland	915 km. (568.6 miles)	Amsterdam, The Hague, Rotterdam, Flushing.
Switzerland	872 km. (541.9 miles)	Geneva, Lugano, Interlaken, Zurich and Chur.
Austria	652 km. (405.1 miles)	Vienna and Bad Gastein.
Poland	127 km. (78.9 miles)	Through the Polish Corridor.
Sweden	31 km. (19.3 miles)	Malmoe.
Denmark	569 km. (35.4 miles)	Helsingor and Copenhagen.
Ferryboats	149 km. (92.6 miles)	Gjedser and Trälleborg.
Czechoslovakia	...	Karlovy Vary and Marianské Lazné.

in number, whereas the *International Sleeping-Car Co.* only works 5 Dutch services *(See table 321)*.

RESTAURANT-CARS (fig. 402). — Normally nearly all the *D* trains include restaurant-cars, which are often worked from end to end. A few, as well as some of the *E* trains, include buffet-cars. The mileage of the lines over which these cars are worked is much the same as that covered by fast trains, and definitely higher than in neighbouring countries, as will be seen from the percentages given for Germany and elsewhere *(see table 322)*.

Mitropa restaurant-cars (figs. 403, 40 and 405) also run beyond the frontier particularly into Holland. The *Interna tional Sleeping-Car Co.* covers all the in ternal services in Holland as well as th services between Holland and Belgium and the *Mitropa* works the German Dutch services, from Amsterdam, th Hook and Flushing to Germany via O denzaal, Zevenaar, Nymegen and Venl The route-mileage is more or less equall divided between the two Companies i this way, but if the vehicle-miles a taken into account, the *Mitropa* has mu the largest share *(see table 323)*.

Table 322.

PROPORTION OF FAST-TRAIN SYSTEM SERVED BY RESTAURANT CARS
(1936 Summer).

Km. (*miles*) of railway.	Countries.	Route-km. (*route-miles*) served by fast trains.	Company working the restaurant cars.	Route-km. (*route-miles*) served by restaurant cars.	Percentage of fast-train routes.	Percentage of whole system.
54 085 (*33 607*)	Germany	21 892 (*13 603 3*)	Mitropa.	17 890 (*11 116.5*)	77.0	33.1
41 910 (*26 042*)	France	15 475 (*9 615.9*)	Int. Sleeping-Car. Co.	12 778 (1) (*7 940*)	82 5	30.6
5 021 (*3 120*)	Belgium	1 585 (*984.9*)	Do.	937 (2) (*582.2*)	59.1	18.7
3 128 (*1 944*)	Holland	1 059 (*680.4*)	Int. Sl.-Car. Co. and Mitropa	808 (*502.1*)	73.8	25.8
16 231 (*10 086*)	Switzerland . . .	...	Int. Sl.-Car. Co., and Swiss Rest.-Car. Co.	1 155 (3) (*966.2*)	...	...

(1) 2 029 km. (1 261 miles) of which served by buffet cars only.
(2) 15 km. (9.3 miles) served by buffet cars only.
(3) Actual mileage, including 47 km. (29.2 miles) worked by the *Mitropa*.

Table 323.

GREGATE LENGTH OF DUTCH LINES SERVED BY RESTAURANT CARS

(fig. 404).

Company.	Length of lines	
	Km.	Miles.
Mitropa	440	273.4
International Sleep.-Car Co.	545	338.6
Both Companies	368	228.7
Total. . .	1 353	840.7

68 km. (228.7 miles) of line are serv- by the two Companies' restaurant-.

Switzerland, restaurant-cars serve ich, Lucerne and Arth-Goldau, via affhausen.

The *Mitropa* also operates the restaurant-car services on the metre-gauge lines of the *Rhaetian Ry.* and of the *Bernina Ry.* For this purpose it has put into service special light stock which has been dealt with (*Bulletin*, July 1935, pp. 852/520 et seq.).

Drawing-room-car services. — Apart from the « Rheingold », the saloon-cars of which now come under this category, there are no longer any services of this kind, as the one between Berlin and Amsterdam was discontinued in 1935.

LVI-3. — **The Int. Sleeping-Car Co.'s German services.** — It is difficult to determine the exact date when the first European sleeping-car service was introduced, but undoubtedly the services between Ostend and Cologne and between Cologne and Berlin were amongst the first.

Fig. 403. — Kitchen of a *Mitropa* restaurant car.

These services developed in the normal way until the War (figs. 406, 407 and 408).

They were re-introduced after the War and now include « de luxe » or Pullman trains and sleeping-car services. The are no isolated Pullman services no with one exception, restaurant-car serv ces.

The Int. Sleeping-Car Co.'s « de luxe

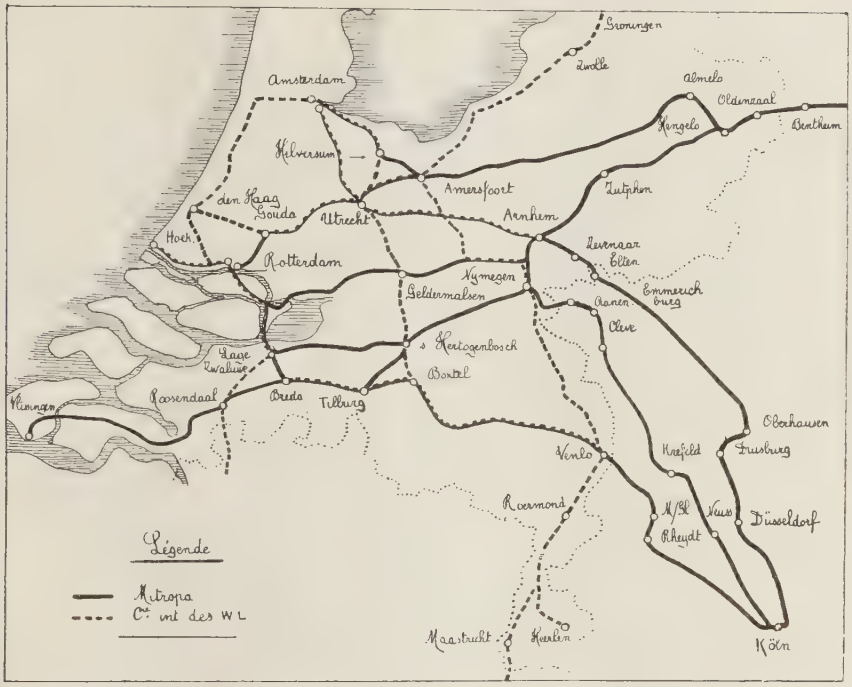


Fig. 404. — Dutch restaurant-car services.
Division between the *Mitropa* and *International Sleeping-Car Company*.

ins (fig. 406) include through services
d trains linking up Berlin with im-
rtant foreign cities.

The oldest of them is the **Orient Ex-**
ess from Paris to Vienna and the Bal-
ns, through the southern German Sta-
, which ran for the first time on the
June 1883. It was discontinued dur-
the war, but afterwards was tempora-
re-introduced and diverted round
thern Germany.

At Stuttgart a rake known as the
Karlsbad Express » before the War and
y called the « *Paris-Prague* » is de-
hed from this train and serves Cze-
oslovakia.

The OSTEND-VIENNA EXPRESS which da-
from the 1st June 1894 was extended to Constantinople in 1901. A rake from Calais which joined it at Brussels was run for ten years, but a through service to Bad-Kissingen, introduced later on, did not last very long. The service from Amsterdam, which joined it at Cologne, is retained as an isolated sleeping-car service.

The NORD EXPRESS, which ran right across Germany from Aix-la-Chapelle towards St. Petersburg, dates from 1896. The Warsaw rake was added in 1899. Diverted after the armistice so as to run round the south of Germany, it reached Warsaw via Prague. In 1921, the second rake, for Riga, was re-introduced in place of that formerly going to Petrograd. In 1924, the train became the « Paris-Ber-

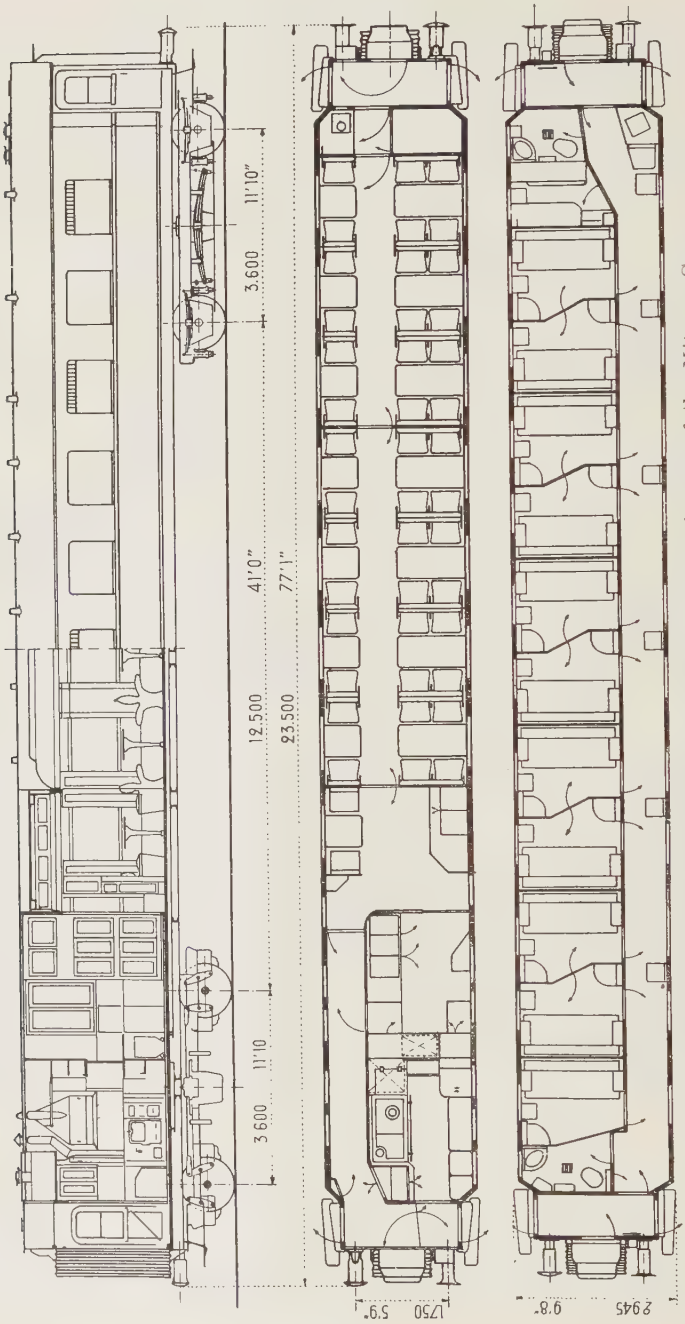


Fig. 405. — Plan of a recent restaurant-car and of a sleeping-car of the *Mitropa* Company.

Fig. 406. — Map of the German sections of the *International Sleeping-Car Company*'s « de luxe » train services.

lin-Riga-Warsaw Express », but the next year its original name was restored. At the present time, the Warsaw rake is reduced to a couple of sleeping-cars attached to an ordinary *Reichsbahn D* train.

Two other through coaches are worked in this train, giving interesting connections, Copenhagen and Hanover (1929), Ostend and Bucharest (via Berlin-Breslau), which gives a connection between Ostend and Bucharest on days when the Ostend-Vienna is not run. Although the routes via Berlin or Vienna are so far apart, the difference in route mileage only represents 2 % of the total distances, which are 2 539 and 2 611 km. (1 577.7 and 1 622.4 miles) respectively via Berlin and via Vienna.

Berlin is served by many trains and international services linking it up with the Near East, with Karlovy Vary and Vienna, with Switzerland, Italy and the

TABLE 324.

GERMAN SECTIONS OF THE INTERNATIONAL SLEEPING-CAR CO.'S AND MITROPA'S TRAIN RUNS.

(Obsolete services are shown in *italics*.)

Origin.	German section.	Destination.	Distance Km.	Distance Miles.	Time of departure.	Time spent.	Speed Km./h.	Speed M.p.h.	Name of train.
	1a. — West to East TRANSIT.								
Ostend. Calais. Paris.	Aix la Chapelle-Berlin Schl.-Neu Bentschen	Warsaw.	806	500.8	12.50 a. m.	10.40	75.5	46.9	Nord Express.
Do.	Aix la Chapelle-Berlin-Eydtkuhnen.	Riga.	1 266	786.6	Do.	18.42	67.6	42.0	Do.
		St. Petersburg.							
Do.	Aix la Chapelle-Hamburg-Padborg.	Copenhagen.	741	460.4	Do.	11.12	66.2	41.1	Do. Isolated carriage.
Do.	then.	Bucharest.	1 133	704.1	Do.	15.36	72.6	45.1	Do.
...	Aix la Chapelle-Berlin Schl.-Beu-Between arrival at Berlin Zoo. and departure from Berlin Schl.	...	9	5.6	...	0.42	12.1	7.5	...
Calais. Paris N.E.	Kehl-Cheb (Eger)	Karl. Vary. Prague.	511	317.5	R 7.52 p. m.	7.52	64.9	40.3	Paris-Prague Express.
...	Strasbourg-Kehl (dep.) run . .	...	8	5.0	2.10 a. m.	0.51	9.4	5.8	...
...	*Strasbourg-Karlsruhe-Heidelberg-Darmstadt-Frankfort.*	...	...	...	...	...	...	...	See services between provincial centres and foreign parts.
	1b. — West to South-East TRANSIT.								
Ostend Q.	Aix la Chapelle-Cologne L. B.-Nuremberg-Cheb	Karl. Vary. *Marienbad.*	688	427.5	12.34 a. m.	10.35	65.1	40.4	Ostend-Karlovy Vary Express.
Do.	*Aix la Chapelle-Cologne-Bad Kissingen*	...	...	...	...	...	...	...	See services between provincial centres and foreign parts.
		Triest.							*Triest Express.*
Ostend Q. *Calais Mar.*	Aix la Chapelle L. B.-Frankfort-Nuremberg-Passau.	Istambul. *Constanza.*	755	469.1	12.34 a. m.	10.21	72.9	45.3	Ostend (Calais)-Vienna Express.
Amsterdam. Paris. Calais.	Emmerich L. B.-Frankfort-Passau	Bucharest.	810	503.3	10.48 p. m.	12.07	66.8	41.5	Do.
	Kehl-Munich-Salzburg.	Istambul. *Constanza.*	559	347.4	3.01 a. m.	7.28	74.8	46.5	Orient Express.
...	Departure from Strasbourg to departure from Kehl.	...	8	5.0	2.10 a. m.	0.51	9.4	5.8	...
	1c. — North to South TRANSIT.								
Amsterdam.	*Emmerich L. B.-Frankfort-Schweiz-*	*Chur.*	692	430.0	5.00 p. m.	11.25	60.6	37.6	*Amsterdam-Switzerland Express.*

(Obsolete services are shown in *italics*.)

Origin.	German section.	Destination.	Distance Km.	Distance Miles.	Time of departure.	Time spent.	Speed Km./h.	Speed M.p.h.	Name of train.
	2a. — INTERNATIONAL SERVICES RADIATING FROM BERLIN.								
...	*Berlin A.-Liegnitz-Breslau-Oderberg*	*Budapest.*	511	31.8	*8.10* a. m.	*7.02*	*72.5*	*45.1*	*Berlin-Budapest-Orient.*
...	*Berlin A.-Leipzig-Eger (Cheb).*	*Vienna K.F.* / *Karlsbad.*	354	220.0	*8.55* a. m.	*5.40*	*62.8*	*39.0*	*Berlin-Vienna Express.*
...	*Id.*	*Karlsbad.* / *Marienbad.*	361	224.3	*11.40* a. m.	*5.49*	*62.0*	*38.5*	*Berlin-Karlsbas-Marienbad.*
...	Berlin Schl.-Breslau-Beuthen	Budapest. / Istambul.	509	316.3	8.04 a. m.	6.51	74.3	46.2	Simplon-Orient sleeping-car.
...	Berlin A.-Dresden Bodenbach	Prague. / Athens.	242	150.4	7.47 a. m.	3.37	66 8	41.5	Do.
...	*Berlin-Leipzig (1) Munich-Kufstein*	*Naples. (Alexandria.)*	785	487.8	*10.32* p. m.	*11.03*	*71.0*	*44.1*	Egypt Express. *(N.D.L.)*
...	*Do.*	*Palermo. Gaord. Taormina.*	Do.	Do.	*11.10* a. m.	*11.17*	*69.5*	*43.2*	*Berlin-Rome-Naples-Palermo.*
...	*Do.*	*Merano. Milan. Cannes*	Do.	Do.	*10.32* p. m.	*11.03*	*71.0*	*44.1*	*N.S. Brenner Express.*
...	*Do.*	*Verona. Rome.*	Do.	Do.	*3.15* p. m.	*11.02*	*71.2*	*44.2*	*Berlin-Tyrol-Rome Express.*
...	*Berlin A.-Halle-Erfurt-Frankfort Strasbourg-Basle.*	*Lucerne.*	905 763	562.4 474.1	*3.40* p. m. *3.40* p. m.	*13.50* *11.30*	*65.4* *66.3*	*40.6* *41.2*	*Berlin-Switzerland Express.*
...	*Berlin A.-Halle-Frankfort-Strasbourg-Mulhouse-Petite-Croix.*	Chur / *Genoa (N.D.L.)*	905	562.3	*3.05* p. m.	*11.42*	*77.3*	*48.0*	*Lloyd Riviera Express.*
...	*Berlin A.-Halle-Frankfort-Strasbourg-Mulhouse-Petite-Croix.*	*Lyons. Ventimiglia.*	962	598.0	*Do.*	*13.09*	*73.1*	*45.4*	*Do.*
(Altona.) (Amsterdam.) (The Hague.)	See under heading 1.								
...	Berlin A.-Leipzig-Frankfort-Mannheim-Karlsruhe-Basle	Cannes. / Rome.	888	551.8	12.51 p. m	10.30	84.5	52.5	Riviera Express.
...	*Berlin Schl.-Hanover-Bentheim.*	*Hook of Holland.*	464	288.3	*12.15* p. m	*6.40*	*69.6*	*43.2*	*Berlin-Hook of Holland Express.* (Mitropa)

TABLE 324*b* (*Continued*).

Origin.	German section.	Destination.	Distance Km.	Distance Miles.	Time of departure.	Time spent.	Speed Km./h.	Speed M.p.h.	Name of train.
	2b. — INTERNATIONAL SERVICES.								
...	*Bad Kissingen-Aix la Chapelle* .	*Ostend Q.*	438	272.2	...	...	...	...	*Ostend-Vienna Express.*
...	Frankfort-Heidelberg-Kehl-Strasbourg	Paris Est.	226	140.4	R 4.33 a. m.	5.06	44 3	27.5	Paris-Prague Express.
...	Cologne-Aix la Chapelle	Ostend Q.	71	44.1	8.42 p. m.	0.51	83.5	51.9	Ostend-Cologne Pullman Express.
	3a. — INTERIOR SERVICES RADATING FROM BERLIN.								
...	Berlin A.-Halle-Augsburg-Munich.	...	678	421.3	9.20 p. m.	10.44 (4)	63.1	39.2	MITROPA. All-sleeping-car train *FD* 70/71.
...	*Berlin A.-Frankfort-Basle* . . .	...	...	...	...	...	...	...	...
...	*Berlin A.-Halle-Fulda-Frankfort* .	...	529	328.7	*8.50* p. m.	*9.52* (2)	*53.6*	*33.3*	*Reichsbahn all-sleeping-car train.*
...	*Berlin Schl.-Dortmund-Duisburg Cologne*	...	588	365.4	*9.35* p. m.	*9.48* (2)	*60.0*	*37.3*	Do. *FD.* 16
...	*Berlin Schl.-Dortmund-Oberhausen-Cologne.*	...	591	367.2	R 7.32 p. m.	*11.50*	*49.9*	*31.0*	Do. *FD.* 15.
	3b. — INTERIOR PROVINCIAL SERVICES.								
...	*Frankfort-Basle*	...	346	215.0	*11.42* p. m.	*6.03* (3)	*57.4*	*35.7*	MITROPA. *All-sleeping-car train D* 4/3.
...	*Warnemünde-Rostock-Kassel-Frankfort-Mannheim-Karlsruhe Basle*	...	1 070	664.9	*5.05* p. m.	*18.45* (2)	*56.6*	*35.2*	MITROPA. *Scandinavia-Switzerland Express.*
	Sassnitz-Rostock-Kassel-Do.-Basle.	...	1 186	738 2	*1.53* p. m.	*22.06* (2)	*53.6*	*33.3*	*Do.*

iera. These services have all been al-ed from time to time, particularly ce the War.

There was only one « de luxe » train m Berlin towards the East, the Ber--Orient Express, which ran via Bres- and Budapest where it joined up with rakes from Paris and Ostend. This in was short-lived. Since the War, lated sleeping-car services from Ber- link up with the « Orient Express » the « Simplon Express ». One of m follows the route of the former « de e » trains as far as Budapest, and the er goes to Vienna and Athens via esden and Prague.

The three Karlsbad (now Karlovy ry) Expresses, from Paris, Ostend and rlin, run right across Germany. The st two are, in actual fact, only rakes m other « de luxe » trains : the « Pa--Karlovy Vary-Prague Express » breaks ay from the « Orient Express » at ttgart and picks up at Nuremberg the Ostend-Karlovy Vary » which is de-ned there from the « Ostend-Vienna ». ly the Berlin train was a special train. e the Ostend train, it also used to ser-Marienbad, and for some time was ex-ded as far as Vienna (Berlin-Vienna ress).

Berlin and the Brenner. — Four « de e » trains, one of which was a boat n, have linked up Berlin with Munich the Brenner by the same route :

he Egypt Express connected at les with the *Norddeutscher Lloyd*'s s from Alexandria ; the other e, the Berlin-Rome-Naples Express, North-South (Brenner) Express, the Berlin-Tyrol-Rome Express were ns from Italy.

« De luxe » trains from Berlin to Basle and beyond. — Before the War, three trains served Switzerland, Italy and the Riviera via the left bank of the Rhine and the St-Gothard.

The « *Lloyd Express* » was also a *Norddeutscher Lloyd* boat train to Genova.

The Berlin-Switzerland Express connected with two other similar trains at Basle, the « Ostend-Switzerland » and the « Amsterdam-Switzerland ».

Finally the Riviera Express before the War started on the one hand from Berlin, and on the other from Amsterdam and Holland. In addition, at Mulhouse a rake was detached for the French Riviera via Lyons and the western end of the Riviera.

The present-day « Riviera Express » is the result of the amalgamation of two series of former trains. Those via the Alsatian bank of the Rhine and Basle were diverted to the Baden bank and the St. Gothard, while the « Berlin-Rome » via the Brenner was made to follow the same route and incorporated in the former. The result is that the present Berlin-Milan Express via the St. Gothard includes two rakes, one to the Riviera, which is reached by the eastern end, and the other for Rome, replacing the former « Berlin-Brenner-Rome ».

With about two exceptions, the present « de luxe » trains follow the same route as before the War; there are no longer any on the Berlin-Frankfort section, while a sleeping-car detached from the « Nord Express » is sent to Beuthen (Bucharest), and sleeping-cars worked in two « de luxe » trains are sent over lines which formerly had no such services :

Fig. 407. — Map of the *International Sleeping-Car Company*'s restaurant-car services

Note: ——— Actual services; - - - - Discontinued services.

from Hanover to Padborg (Copenhagen) (« Nord Express ») and from Cologne to Emmerich (Amsterdam) (« Ostend-Vienna Express »).

RESTAURANT-CAR SERVICES (fig. 407). — These services, which were very extensive before the War, there being 68 covering 10 336 km. (6 422 miles) of line, ha been completely discontinued with t single exception of the German Cologn Aix-la-Chapelle-Herbestal section, inclu ed in the services between Cologne a Brussels, Ostend or Paris.

The only point to be noted about t

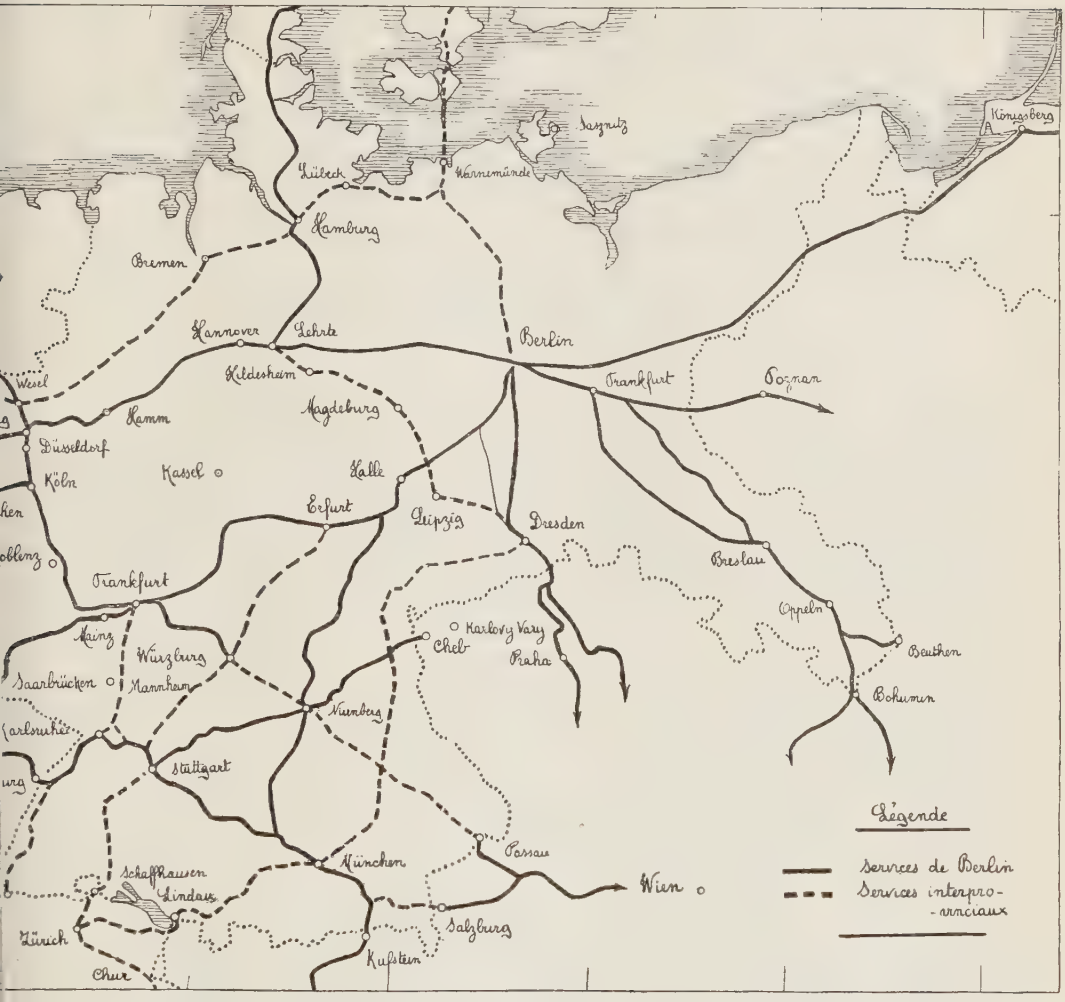


Fig. 408. — Map of the *International Sleeping-Car Company*'s sleeping-car services.

Explanation: ——— Services from Berlin; - - - - - Interprovincial services.

ner services is that they included e triangular services (1).

SLEEPING-CAR SERVICES (fig. 408). — If the route-mileage worked by isolated

) *(a)* From Cologne to Halle and Breslau back from Breslau to Scherfede, and e to Leipzig, then from Leipzig to Co-;

) From Nuremberg to Leipzig, thence to Reichenhall, then to Dresden, and Nuremberg;

(c) From Munich to Saarbrücken via Stuttgart and back from Stuttgart to Heidelberg, then from Baden-Baden to Munich.

coaches detached from the « de luxe » trains is included in the total mileage of lines served, the total system served has not decreased as compared with the pre-war services.

In Germany, as elsewhere, a supplement is charged which takes into account not only the night spent in the sleeping-car, but also the mileage worked by the latter.

Apportionment of the services. — During the 1936 summer, the services were shared by the two Companies as shown in table 325.

TABLE 325

SLEEPING-CAR AND RESTAURANT-CAR SERVICES OF THE INTERNATIONAL SLEEPING-CAR CO. AND THE MITROPA.

(Discontinued services are shown in *italics.*)

Service or train.	*International Sleeping-Car Co.*, in 1914.		*International Sleeping-Car Co.*, in 1936.		*Mitropa*, in 1936.	
	Number.	Km. (Miles).	Number.	Km. (Miles).	Number.	Km. (Miles).
« De luxe » trains	8 + *2*	5 736 + *879* (3 564 + *546*)	4	2 563 (1 593)	*2*	*1 664* (*1 034*)
Isolated coaches	1 + *1*	146 + *544* (91 + *338*)	5	1 799 (*) (994) (*)	0	...
All-sleeping-car trains	0	...	0	...	1 + *4*	678 + *1 515* (421 + *941*)
Drawing-room-car or Pullman trains	0	...	1	71 (44)	*1*	*652* (*405*)
Sleeping-car services	30	6 254 (4 053)	20	4 442 (2 760)	80	13 097 (8 138)
Restaurant-car services	68	10 336 (6 423)	1	71 (44)	205	17 896 (11 120)
Drawing-room-car services	0	...	0	...	1	652 (405)

(*) This total is made up as follows :

Nord Express	613 km. (380.9 miles)	Berlin-Eydtkuhnen (Riga).
Nord Express	429 km. (266.6 miles)	Berlin-Beuthen (Bucharest).
Nord Express	376 km. (233.6 miles)	Hanover-Padborg (Copenhagen).
Ostend-Vienna.	139 km. (86.4 miles)	Cologne-Emmerich (Amsterdam).
Ostend-Vienna	...	Nuremberg-Eger (Prague) (See *Paris-Prague Express).*
Ostend-Vienna	...	*Bad Kissingen (obsolete).*
Paris-Prague	...	Karlsruhe-Frankfort.
Simplon-Orient	242 km. (150.4 miles)	Berlin-Tetschen (Prague, etc.).

(To be continued.)

[621. 43 (.437)]

The « Slovak Arrow ».

A new fast railcar service between Prague and Bratislava,

by Paul KOLLER,

Chief mechanical Engineer, Member of the Board of Directors, Czechoslovak State Railways.

General.

In view of the length of their System from east to west (the Cheb-Prague-Jasina line is 1 280 km. = 795.4 miles long), the Czechoslovak State Railways have every reason for speeding up their services. Unfortunately the condition of the track is not favourable as a whole for high train speeds, owing to the many curves of small radius (curves of 300 m. = 15 chains radius are frequent on the main lines) and to the axle load being restricted to 16 tons, even on the main lines.

During recent years, an endeavour has been made to improve the condition of the lines, especially of a number of lines of great importance. A programme, partly completed already, provides for relaying the trunk lines with 50-kgr./m. (101 lb. per yard) rails, for a maximum axle load of 20 tons, the maximum speed being 120 km. (75 miles) an hour. The programme also provides for the relocation of certain particularly difficult sections as regards high speeds. Still higher speeds will be made possible at a later date.

The cost of this programme is considerable and the time to complete it is long, for which reason markedly accelerated steam train services will only materialise after some years. The country, however, needs faster services between the capitals of the three countries forming the Republic, i. e. Prague (Bohemia), Brno (Moravia) and Bratislava (Slovakia).

The present expresses take 5 h. 57 m. to 6 h. 36 m. for the 397 km. (246.7 miles) between Prague and Bratislava. The intention was to reduce this time to about 4 1/2 hours and thus enable passengers to easily make the return journey between Bratislava and Prague in the same day, with sufficient time in Prague for business purposes.

To this end, the Administration decided to put into service a fast light railcar of a new design, carried on two bogies, with a 330-h.p. petrol engine, the axle-load not exceeding 11 tons, so as to make high speeds possible. Two vehicles were ordered, in 1934, from Messrs. Tatra, of Koprivnice (Moravia).

These railcars were delivered in June 1936, and after a series of trials, were put into regular service on the 13th July 1936, the distance run daily being 794 km. (493.4 miles).

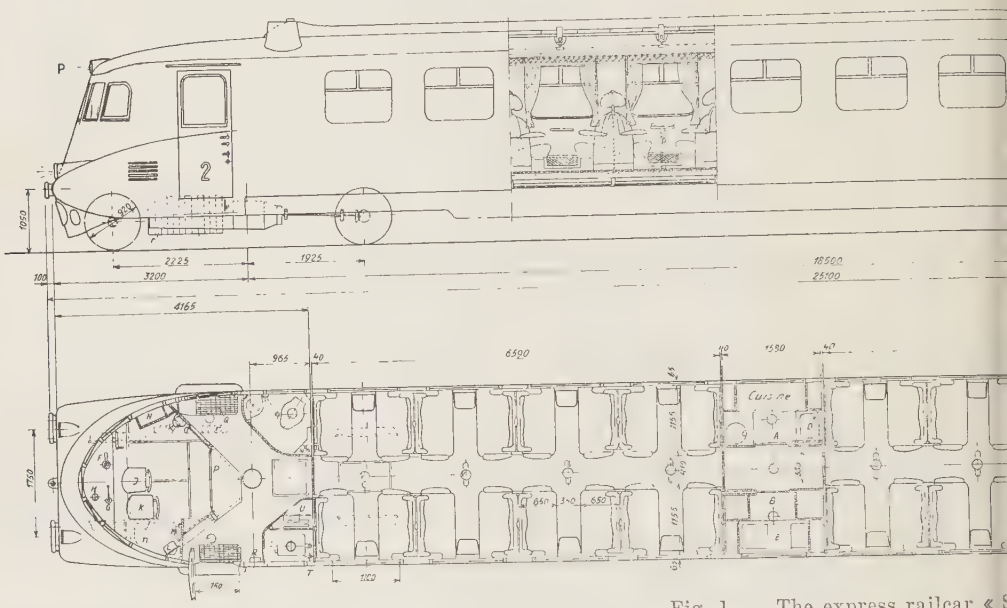
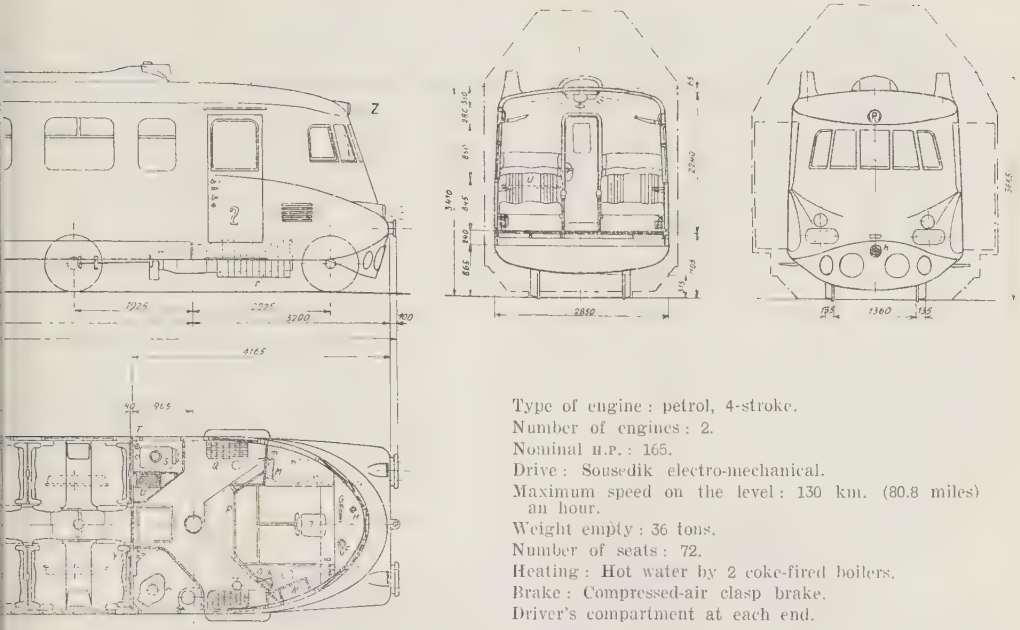


Fig. 1. — The express railcar « S

Fig. 2.



Type of engine : petrol, 4-stroke.
Number of engines : 2.
Nominal h.p. : 165.
Drive : Sousedik electro-mechanical.
Maximum speed on the level : 130 km. (80.8 miles) an hour.
Weight empty : 36 tons.
Number of seats : 72.
Heating : Hot water by 2 coke-fired boilers.
Brake : Compressed-air clasp brake.
Driver's compartment at each end.

the Czechoslovak State Railways.

The fast service between Prague and Bratislava, worked by these new railcars, is known as the « Slovenská Strela » (Slovak Arrow).

These services (one per day in each direction) are available only to passengers who have booked their seats in advance.

Description from the constructional point of view.

Main features.

The railcar is carried on two long-wheelbase bogies, one pair of wheels being driven and the other carrying only (figs. 1 and 2). The drive is electro-mechanical.

The following are the *leading features and dimensions* :

Nominal power of each engine	165 h.p.
Fuel used	Petrol.
Number of cylinders	6
Bore	140 mm. (5 1/2″).
Stroke	180 mm. (7 3/32″).
Maximum number of r.p.m.	1 400
Number of bogies	2
Number of pairs of wheels per bogie	2
Bogie wheelbase	4.15 m. (13′ 7 3/8″).
Distance between bogie centres	18.50 m. (60′ 8 11/32″).
Diameter of wheels	920 mm. (3′ 1/4″).

Length of vehicle over buffers	25.10 m. (82′ 4 3/16″).
Overall width of body	2.85 m. (9′ 4 3/16″).
Weight of railcar empty	36 000 kgr. (79 366 lb.).
Weight of railcar loaded	42 580 kgr. (93 873 lb.).
Maximum axle load	11 020 kgr. (24 295 lb.).
Number of seats	72
Weight per seat	591 kgr. (1 301 lb.).
Maximum speed allowed	130 km. (80.8 m.p.h.).

The following are the most interesting constructional features :

(1) *Bogie* (fig. 3).

The one-piece forged steel wheels are mounted on axles of special steel. The inside part of the tyres is used as the brake drum. The inside axles-boxes are fitted with roller bearings. The boxes on an individual axle are connected together either by a tube surrounding the axle in the case of the carrying axle or, in the case of a driven axle, by a cross box stay housing the gears driving the

Fig. 3.

axle. The boxes are attached to the bogie, both at the top or bottom by radius rods taking the torsion due to the accelerating or retarding forces. The top arms are reinforced by diagonals and the parallelogram so provided prevents the axles getting out of line. Laminated bearing springs are provided between the bogie frame and the axle boxes, one end resting on the bogie and the other on the above mentioned parallelogram.

The bogie frames are made in the form of a lattice girder. The ends are connected together by pressed steel headstocks reinforced by diagonal cross bearers and at the middle by the body bolster. The details are electrically welded together.

There is no bogie bolster. The bogie centre merely acts as a guide for the body and carries no load. It is held in place laterally by rubber blocks, the body being prevented from lifting.

The body rests on 4 rollers solid with the bogie frame. The weight of the body is not transmitted directly; there is an equalizer between the body bolster and the rollers, the underside of the equalizer

utomatically acting as the path of the ollers. The two ends of the lever house he coiled springs. The vibrations are lamped out by silent-blocks between the ogie bolster and the seats of the springs.

Each bogie carries two compressed-air rake cylinders, each carried on a sole ar. Each cylinder operates the clasp rakes on both wheels on the correspond-ng side of the bogie. The brakes are ined with Ferodo and can also be operat-d by hand.

The pivots of the radius rods connect-ng the axle boxes to the bogie frame nd the pivots of the rollers carrying the ody are oiled automatically by a lubri-ator operated by the vertical movements f the body.

(2) *Body.*

The body frame consists of drawn steel ubes, either circular or rectangular, with hin walls. The lower sills, sides and oof provide a rigid construction all parts f which carry their share of the load. he body is electrically welded through-ut.

The sidewalls consist of the upper and ower side sills and the outside steel pa-elling. The inside lining consists of lywood covered with special fabric. The oof consists on the outside of riveted alvanised steel plating painted over. It s lined inside with plywood covered ith fabric. Between the outside plates nd the inside wood panelling of the roof nd sides are four layers of « Alfol ».

The outside shape of the body has been ased on wind tunnel tests. At each end f the body are doors opening into a ves-bule giving access to the passenger and river's compartments. The driver's com-artment not being used can be loaded ith luggage, etc. and be screened over y gratings. Each end also has a lava-tory and hot water heating boiler. A swing door gives access to the passenger compartments. Each railcar has 2 second-class compartments, one with 40 seats, smoking, and the other 32, non-smoking. At the middle of the body a small corridor between the two passenger compartments gives access by sliding doors to the kitchen and pantry.

The compartments are fitted up in such a way as to give an air of pleasing simplicity and repose (fig. 4). Though the space per seat is limited, the upholstered seats are most comfortable and are fitted with head rests to make the journey as little tiring as possible. The seats are arranged to face one another in pairs on each side of the central corridor. Tables can be fitted between the seats for meals.

Forced ventilation is provided. The air is driven through a duct along the centre line of the roof and discharged into the compartment through adjustable ventilators.

The lower part of the railcar, containing the compressed-air reservoirs, accumulators, tool boxes, brake pipe and wiring is completely cased in by a demountable casing in aluminium.

The railcar is fitted with a dead man's handle, so that the vehicle stops automatically if the driver fails.

(3) *Engines.*

The railcar has two driving sets. Each set consists of a petrol engine and transmission carried on the bogie through three-point elastic suspension. The vertical 4-stroke 6-cylinder petrol engine is water cooled. The radiators are arranged along the solebars. The cooling water is circulated by a pump mounted on the engine.

The exhaust gases discharge through

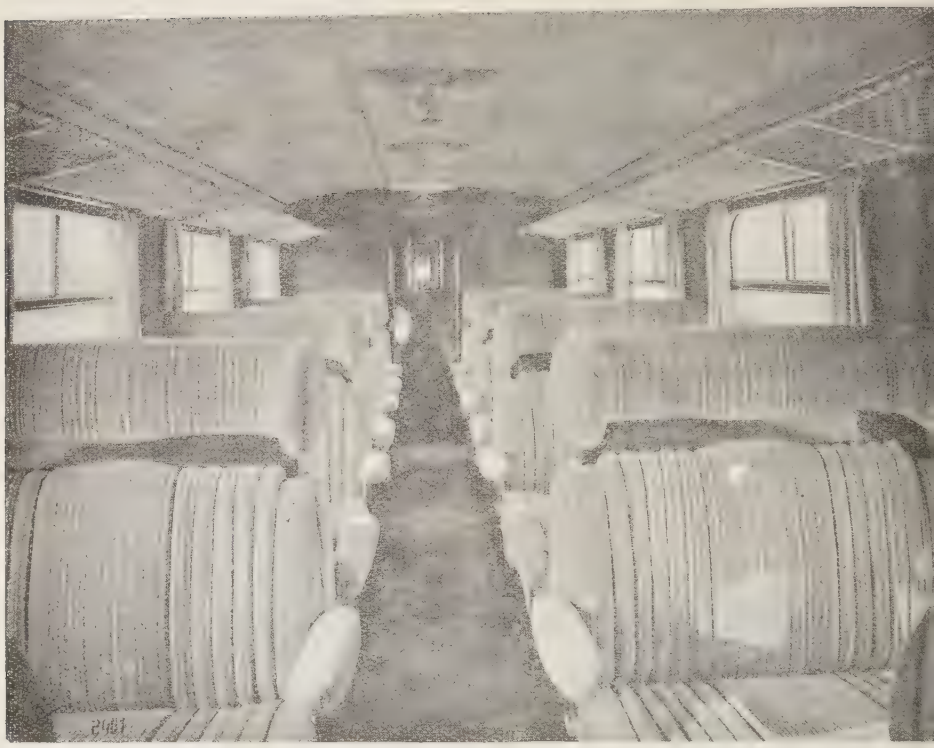


Fig. 1.

a silencer on the bogie and escape above the roof. Each power set also includes a compressor, a lighting dynamo and various auxiliaries.

(4) *Transmission.*

The Sousedik transmission is of an original design. It combines to a large extent the advantages of the electric drive — ease of regulation and progressive change of speed — and those of the mechanical drive — high efficiency and low weight — whilst avoiding a good deal of the drawbacks of the two systems.

The petrol engine crank shaft carries at one end the stator of a specially designed generator, the rotor of which is connected to the bogie driving axle cardan shaft. When the petrol e is running the stator revolves at the speed whereas the rotor is only d slowly, and at first revolves at a lower speed than the stator. The ference in speed between the two of the generator generates an el current which feeds an auxiliary tr electro-motor (fig. 5). The latter through gears at the same time a rotor the cardan shaft and bogie d axle. When starting, the traction drives the vehicle. The speed of ro of the rotor progressively increases the growing vehicle speed, as do power transmitted by the electro-n

c couple between the stator and the ro-
r.

The series excitation of this generator regulated by shunts. The acceleration f the vehicle therefore is due to the

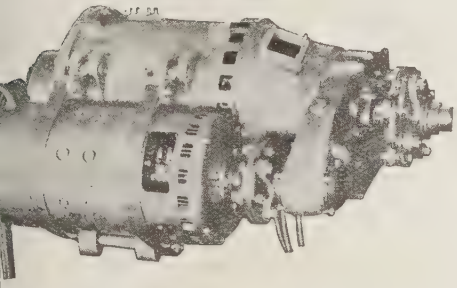


Fig. 5. — Generator with electro-motor.

tion of both the rotor and of the trac-
on electro-motor, the electrical losses ing reduced to the minimum. When e speed of rotation of the rotor ap-roaches that of the stator (at about 80% the maximum speed) an electro-mag-tic disc clutch inside the generator uples the rotor and stator together to ve a direct mechanical drive. The ansmission being mechanical, the ge-nerator no longer produces current, as there is no relative movement between the stator and rotor. As the electro-motor, which drives through a free wheel, receives no current, it stops.

The conditions under which the different parts of the transmission work are indicated in diagram I in which :

Np = power of the petrol engine supposed constant from 35 km. (21.75 miles) up to 130 km./h. (80.8 miles) an hour;

Nes = power transmitted by the electro-magnetic couple between the stator and the rotor;

Neg = power transmitted by the current of the generator;

Nem = power of the electro-motor;

Nk = power at the cardan shaft;

η = efficiency of the transmission.

The following general relations are agreed :

$Np = Nes + Neg;$

$Nk = Nes + Nem.$

In the diagram, in which $Np = 100\ \% = 1$, we can put $\eta = Nk$ from 35 to 130 km. (21.75 to 80.8 miles) an hour, i. e.

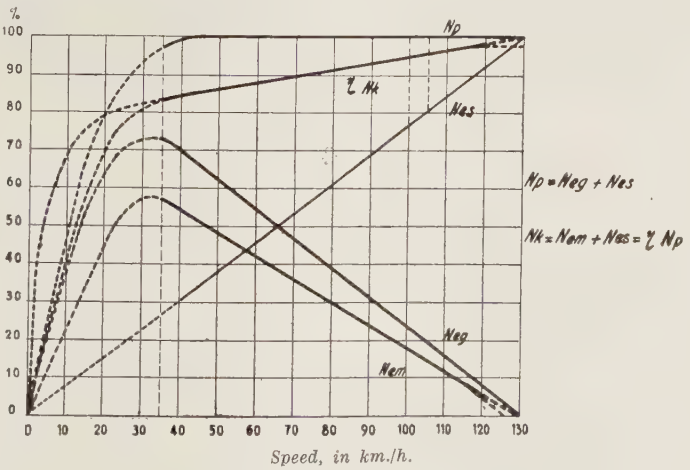


Diagram I. — Power curves.

in the speed range in which the prime mover works at full power.

The efficiency of the transmission is 80 % at 30 km. (18.6 miles) an hour and approaches 100 % (direct drive) at the maximum speed of 130 km. (80.8 miles) an hour.

A specially designed automatic device, which can be hand-operated as well, controls the clutch. This device works in conjunction with the acceleration lever and the centrifugal governor of the petrol engine, and is fitted on the driver's control board.

The power is transmitted to the driving axle through a secondary shaft with universal joints to compensate the movements of the vehicle springs, and through bevel gears.

Reversing is by means of a compressed-air operated clutch mounted on the driving axle.

The leading features of the transmission are :

a) D. C. series-excited generator :

Number per car	2
Power, hourly rate	52.8 kw.
Power, continuous	42.9 kw.
Number of poles	6

b) D. C. series traction motor :

Number per car	2
Power, hourly rate	50 kw.
Power, continuous	40 kw.
Number of poles	4

The power of both the generator and the electric traction motor is low relatively to that of the petrol engine, as they are only used during starting.

(5) *Control.*

The two driving sets can be driven at the same time from each driver's compartment. If one set fails, the other set can haul the vehicle.

Results of trials.

The principal characteristics of t railcar were ascertained by a series trials. The maximum speed over an ea road was 148 km. (92 miles) an hou The railcar can attain a speed of 130 k (80.8) an hour from rest in 175 second the initial acceleration being at the ra of 0.46 m. (1.5′) per sec. per sec.

Diagrams II and III are speed/tir curves. In diagram III the curve *a* r

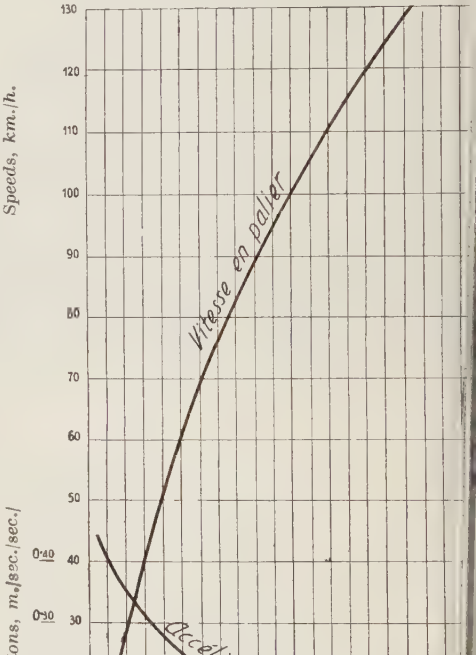


Diagram II. — Starting curves of the «S Arrow » under full power.

Note. — Vitesse en palier = speed on the le

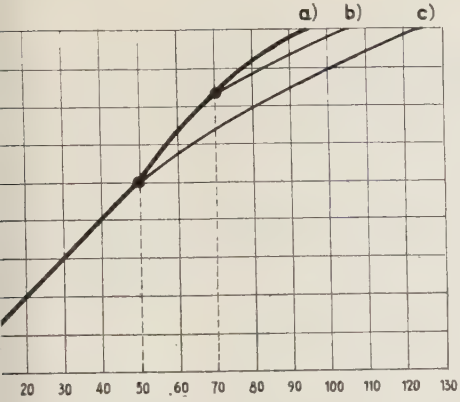


Diagram III. — Starting curve.

sents starting on a rising gradient, the ctric drive being used up to 90 km. 3 miles) an hour. Curves *b)* and *c)* w the change to mechanical drive at km. (45.4 miles) an hour and at 50 . (31 miles) an hour. The starting iod is therefore longer if the mecha- al drive is used at low speeds. The ed of 130 km. (80.8 miles) an hour still be sustained up a gradient of n 125, and 100 km. (62 miles) an hour 1 in 71. The speeds allowed on down dients, in view of the maximum brak- distance of 700 m. (766 yards) are :

on a 1 in 100 down gradient, 130 km. (80.8 miles) per hour;

on a 1 in 33 down gradient, 120 km. (75 miles) per hour.

The petrol consumption of the two engines averages 490 grammes per km. (1.75 lb. per mile).

The commercial speed over the full Prague-Bratislava run is about 82 km. (51 miles) an hour, an appreciable increase over the average of 70 km. (43.5 miles) an hour with the fastest steam train. Next year, the time will be reduced to 262 minutes and the overall speed will then be 91 km. (56.5 miles) per hour.

The trials carried out with the new type of railcars on other main lines have been such that the prospects of extending their use are favourable. On the Bohumin-Kosice (354 km.) run, for example, the overall speed was 84 km. (52.2 miles) an hour, as compared with 60 km. (37.3 miles) an hour with the best steam trains.

So far the trials have given good results technically and from the point of view of the passengers, who appreciate more especially the steady running at high speeds. Consequently the services are very well patronised.

[621.131.1 & 621.131.2]

The horse-power of locomotives. Its calculation and measurement,

by E. L. Diamond, B. Sc. (Eng.), A. M. Inst. C. E., A. M. Inst. Mech. E.

Following the publication, in the February 1936 Bulletin, *of* Mr. Diamond's *article on the power of locomotives, the* Deutsche Reichsbahn *sent us the following letter, which completes certain passages of the said article. We submit these interesting remarks to our readers' attention.*

* * *

In reviewing the development of the German test methods, Mr. Diamond reports that, at a Conference of German State Railway Engineers, at which Prof. Lomonossoff was present, it was decided to adopt the Russian testing method. Actually, it is during the Technical Session and the Railway Exhibition at Seddin, in 1924, that some exchanges of scientific views took place with eminent foreign experts, including Prof. Lomonossoff. During these meetings, Prof. Lomonossoff also mentioned Prof. Czeczott's method with an auxiliary engine.

No official discussion on the proposition took place, nor was any decision taken on the Russian method; moreover a long uniform gradient as found in Russia, did not exist in Germany.

Mr. Diamond also stated that Prof. Nordmann, in 1925, followed Professor Czeczott's method and introduced the practice of employing an auxiliary engine. This was not a vital modification of the Czeczott method, but really a method based on an entirely new principle. The brake-locomotive used in the German method obviously is not an assisting locomotive, but simply a means of producing train resistance, whereas in Pro Czeczott's method the second engine only employed *to regulate the tracti effort* to haul the train which provid the main load.

Neither was the method of using brake locomotive based on the Czeczo method; it was developed quite indepe dently, as is shown hereafter. The cou ter-pressure brake was considered as very suitable additional brake whic could be used when working hea goods trains down heavy gradients, a the quantitative effect of which was fir of all to be ascertained by tests. The te on the resistance of the brake locomoti were carried out running down vario gradients, and according to the origin considerations. When carrying out t tests with several types of locomoti with counter-pressure brake, in order get results more quickly than would possible by a productive test down a g dient, followed inevitably by an imp ductive run up a gradient, the 1924/19 tests, as suggested by Messrs. Günth Reichsbahnrat, and Koch, Dipl. Ing., the Berlin-Grunewald testing stati were carried out on easy down gradie and even on the level, and the grav effect replaced almost entirely by t tractive power of a running locomoti The very effective train resistance as presented by the brake locomotive s gested to these two Engineers the i of reversing the test conditions, so t the object of the test was not the br locomotive, but the train locomotive, brake locomotive merely having to p duce the required variable train re

nce. This idea was introduced by Prof. ordmann in the programme of trials on nger level sections in order to deter- ine *experimentally* the power of the comotive at full boiler output in terms the speed, subsequent to founded ubts having already been thrown on rahl's theory on constants applicable to l types of locomotives as a result of sts already carried out. All the tests ade up to 1929 confirmed these doubts, id for this reason too the Reichsbahn dopted the experimental method in ace of uncertain calculations based on formula. The brake locomotive method s been used on the Reichsbahn since e end of 1926 for low-speed engines, and since the autumn of 1927 for high-speed engines, as standard practice. So far as we know the French railways also use the brake locomotive in their trials at constant speed and not a locomotive marshalled in the train as in the Czeczott method.

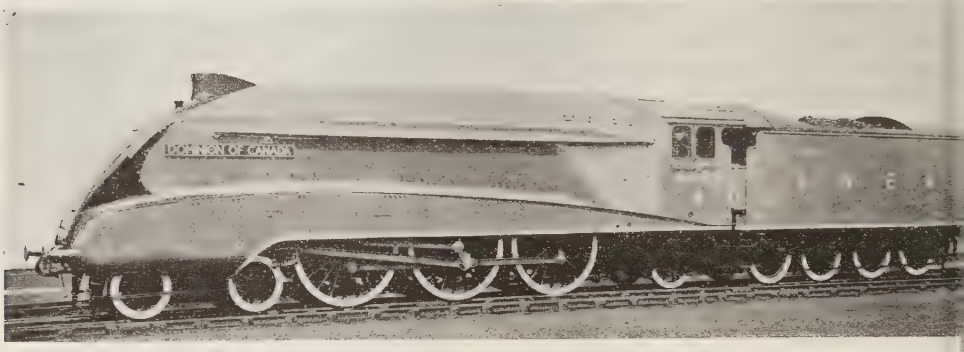
Although there is no reason why a railway should not use any sound scientific method borrowed from another railway, in the case in question, the German test method was developed by the Reichsbahn on entirely independent lines.

The General Management of the German State Railways.

RECENT DEVELOPMENTS.
IN RAILWAY PRACTICE.

621. 132. 3 (.42) & 625. 232 (.42)]

New «Coronation» trains for the King's Cross - Edinburg high-speed service, London and North Eastern Railwa



The London & North Eastern Railway Company were pioneers in the provision of high-speed « limited » trains in Great Britain, and in extension of this policy are introducing new high-speed services between King's Cross and Edinburgh, which commenced on July 5th, 1937.

The trains, which bear the name « Coronation » by permission of H. M. The King, run daily from Monday to Friday in each direction, leaving King's Cross at 4. p. m. and Edinburgh at 4.30 p. m., the journey in either direction being accomplished in six hours at an overall average speed of 65.5 m. p. h.

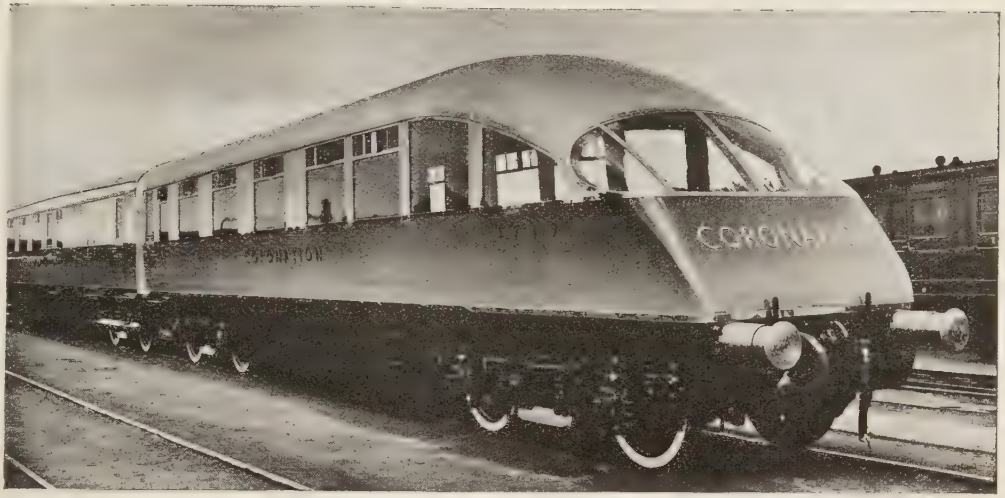
The train from London to Edinburgh makes an intermediate stop at York, providing connections with the Yorkshire cities. The up train in the opposite direction stops at Newcastle to provide a fast evening service from Newcastle and district to London.

The high average speed is maintained by running at fast speed up hill and not by excessive speeds on falling gradients. The train from London to Edinbu covers the distance of 188 miles to Y at an average speed of 71.9 m. p. h.

Entirely new locomotives and roll stock of striking design have been b for this service at the Doncaster Wo of the Company, to the designs of Chief Mechanical Engineer, Sir Ni Gresley, C.B.E. to whom we are indeb for the present information.

The trains are streamlined and the terior is practically flush from end end; the front of the engine is sha to reduce head resistance and to fa tate air flow; the spaces between the dividual carriage bodies are covered india-rubber fairings and the sp between the wheels by steel fairi whilst the end observation car is sha to complete the streamline form of whole.

The method of streamlining ado causes the least disturbance to pass trains, whilst at the same time provi in the case of the engine an excel



smoke raising device, and in the case of the tail car a form of streamlining which offers the least resistance to both head and side winds, and is based on the results of extensive tests carried out at the National Physical Laboratory.

The formation of the train is shewn on the diagram.

The chief characteristics of the five streamlined locomotives which have been built to operate these trains are similar to the « Silver Link » type which was designed to haul the « Silver Jubilee » express and which has been such an outstanding success (1). The engines are painted in Garter blue with stainless steel lettering and mouldings, the wheels being painted coronation red and the tyre rims left bright.

The engines have been named as follows :

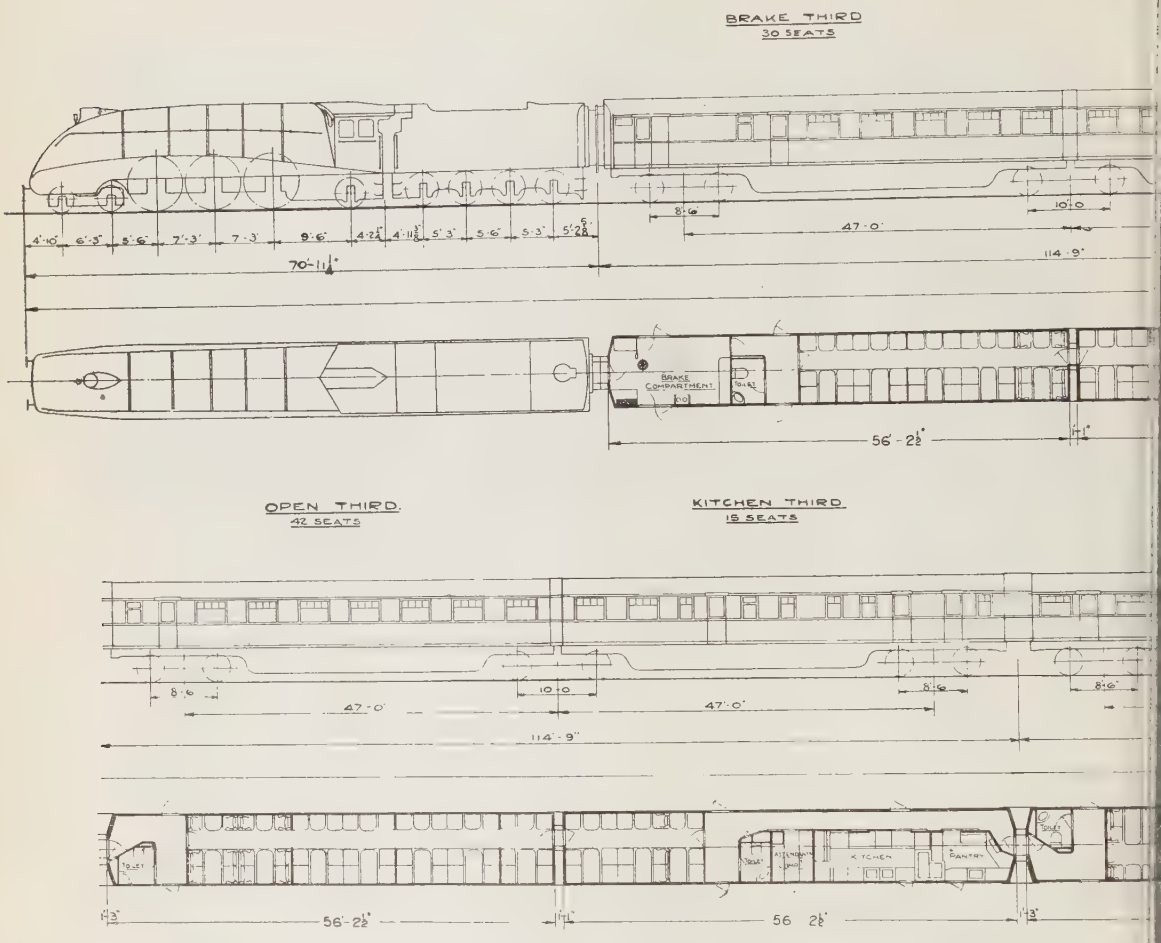
« Dominion of Canada » . . .	No. 4489
« Commonwealth of Australia »	No. 4491
« Dominion of New Zealand »	No. 4492
« Union of South Africa » . .	No. 4488
« Empire of India »	No. 4490

(1) See *Bulletin of the Railway Congress*, November 1935, p. 1299.

By permission of the respective Governments, the armorial bearings of each country have been displayed on the cab of the engine concerned, and in the case of « Empire of India » an emblem comprising a plain shield with the Star of India surmounted by the Imperial Crown has been shewn. The engines are further distinguished by the fact that the whistle of « Dominion of Canada » has been specially sent from Canada by the Canadian Pacific Railway Company and has, of course, the distinctive note of the whistles heard in that country, whilst in the case of « Union of South Africa » a whistle as used on the South African Railways has been fitted.

The leading dimensions are as follows :

Length over buffers.	71′ 0 3/8″.
Weight in working order	167 tons.
Boiler pressure . .	250 lb. per sq. in.
Diameter of driving wheels.	6′ 8″.
Cylinder diameter .	18 1/2″.
Stroke.	26″.
Tractive effort . .	35 500 lb.



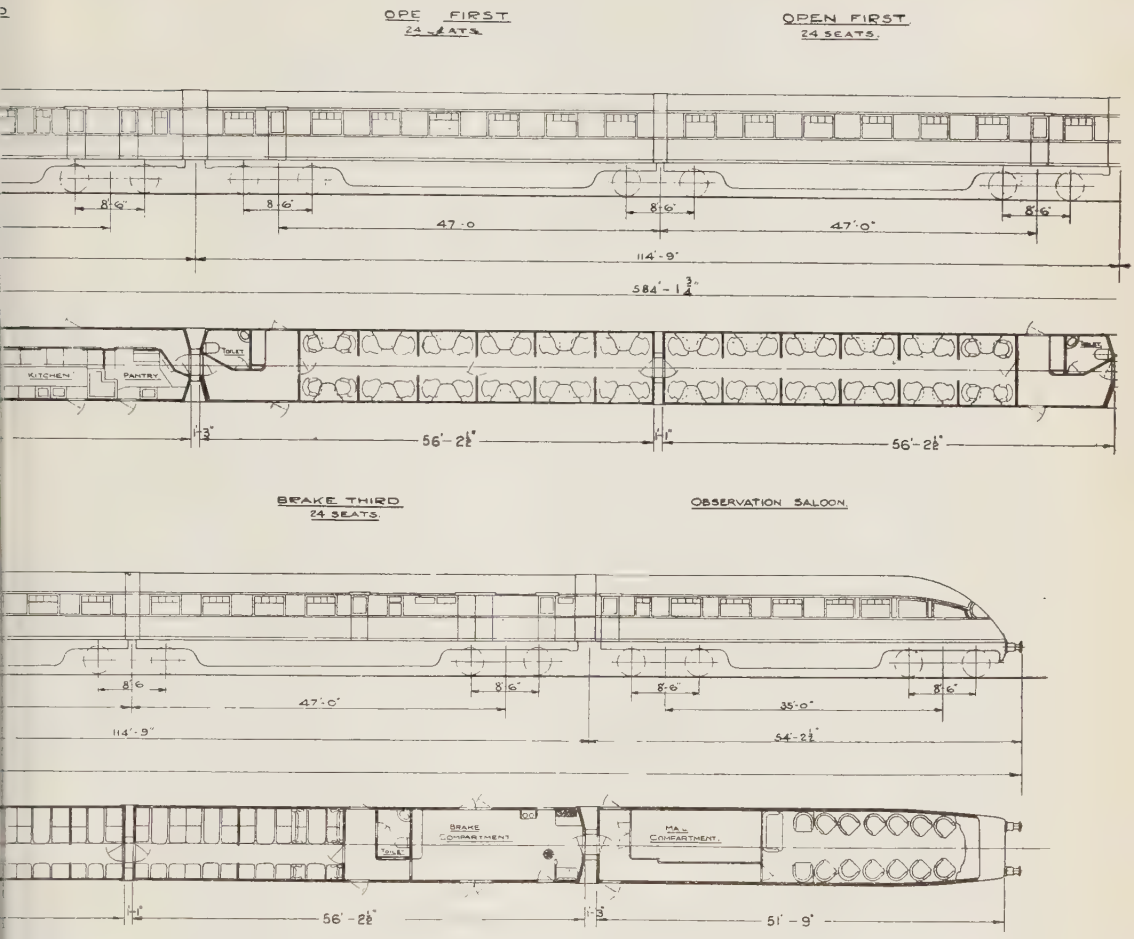
Formation of train

The corridor tender follows the general scheme of streamlining and carries 8 tons of coal and 5 000 gallons of water.

Each train comprises nine vehicles weighing 312 tons, the total length over buffers (including the engine) being 584 feet 2 inches.

The vehicles are of the open saloon type and are arranged as four pairs of articulated twin cars with a streamlined observation saloon at the rear of the train. The formation when leaving King's Cross is as follows :

Engine	*Seats.*	*Weight.* T.	C.	Q.
Brake third	24	62	18	3
Open third	42			
Kitchen third	15	74	11	2
Open third	42			
Open first.	24	65	18	1
Open first.	24			
Kitchen third	15	74	15	1
Open bk. third	30			
Observation car	16	33	16	1
		312	0	0



l Edinburgh service.

Each articulated body is 56′ 2 1/2″ long, whilst the observation car is 51′ 9″ over body, the width of each car being 9′ 0″ over mouldings.

Seats are provided for 48 first-class and 168 third-class passengers, excluding the observation car in which accomodation cannot be reserved and in which meals will not be served.

The exterior finish of the train is of striking character, the upper portion of the body side being in Marlborough blue and the lower portion in Garter blue. Synthetic paints have been employed throughout. The window frames, exterior mouldings and fittings are of stainless steel. The roof is painted aluminium and the bogies and bottom skirting are finished black. The bodies of the vehicles are teak framed and are panelled with steel plates.

To ensure a quiet interior the whole of the body sides and roof are insulated with asbestos acoustic blanket. Special attention has been given to the floors. In addition to a 1/2″ sheet of sponge

Point to point mileages, running times and speeds.
King's cross, York and Edinburgh.

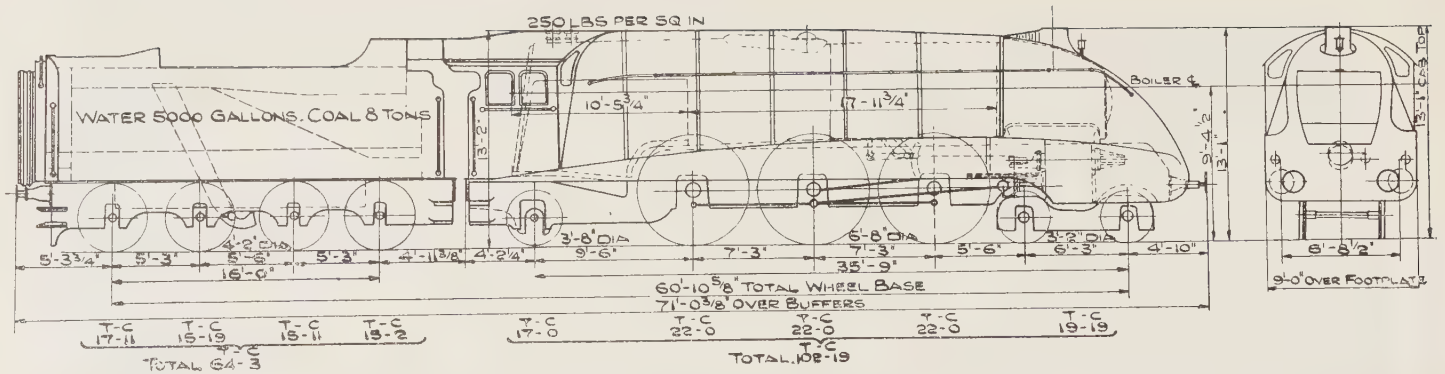
Distance from King's Cross. Miles	chns.	Station.		p. m.	Point to point. Time, minutes.	Distance, miles	chns.	Speed, m.p.h.
		King's Cross.	dep.	4. 0				
17	54 1/2	Hatfield	pass.	4.18 1/2	18 1/2	17	54 1/2	57.3
31	73 3/4	Hitchin.	«	4.29 1/2	11	14	19 1/4	77.7
58	69 3/4	Huntingdon	»	4.48 1/2	19	26	76	85.
76	29	Peterboro'.	»	5. 3 1/2	15	17	39 1/4	70.
105	36 1/2	Grantham.	»	5.27 1/2	24	29	7 1/2	72.7
120	8 1/4	Newark.	»	5.39 1/2	12	14	51 3/4	73.3
138	49 1/4	Retford.	»	5.54 1/2	15	18	41	74.
155	77	Doncaster.	»	6. 8 1/2	14	17	27 3/4	74.3
160	16	Shaftholme	»	6.12 1/2	4	4	19	63.5
174	25	Selby	»	6.24	11 1/2	14	9	73.6
188	11	York.	arr. dep.	6.37 6.40	13	13	66	63.8
210	27	Thirsk	pass.	7. 1 1/2	21 1/2	22	16	61.8
218	7	Northallerton	»	7. 8 1/2	7	7	60	66.4
232	21	Darlington	»	7.21	12 1/2	14	14	68.
245	9	Ferryhill	»	7.33	12	12	68	64.25
254	24	Durham	»	7.45	12	9	15	45.9
268	27	Newcastle.	»	8. 0	15	14	3	56.1
284	77	Morpeth	»	8.21	21	16	50	47.5
303	16	Alnmouth.	»	8.37	16	18	19	68.4
319	79	Belford.	»	8.51 1/2	14 1/2	16	63	69.5
335	27	Berwick	»	9. 5	13 1/2	15	28	68.2
336	29	Marshall Meadows. . .	»	9. 6 1/2	1 1/2	1	2	41.
346	49	Reston	»	9.17	10 1/2	10	20	58.5
351	49	Grantshouse	»	9.22	5	5	0	60.
363	49	Dunbar.	»	9.32	10	12	0	72.
375	9	Drem	»	9.41 1/2	9 1/2	11	40	72.6
379	49	Longniddry	»	9.45 1/2	4	4	40	67.5
386	57	Monktonhall.	»	9.51 1/2	6	7	8	71.
389	69	Portobello.	»	9.55	3 1/2	3	12	54.
392	69	Edinburgh.	arr.	10. 0	5	3	0	36.

King's Cross-York : 188 miles 11 chns. in 2 h. 37 m. Average speed = *71.9 m.p.h.*
York-Edinburg : 204 miles 58 chns. in 3 h. 20 m. Average speed = *61.4 m.p.h.*
King's Cross-Edinburgh : 392 miles 69 chns. in 6 hrs. Average speed = *65.5 m.p.h.*

Point to point mileages, running times and speeds.
Edinburgh, Newcastle and King's cross.

Distance from Edinburgh, miles	chns.	Station.		p. m.	Point to point. Time, minutes.	Distance, miles	chns.	Speed, m.p.h.
		Edinburgh.	dep.	4.30				
3	0	Portobello.	pass.	4.34 1/2	4 1/2	3	0	40.
6	12	Monktonhall.	»	4.38	3 1/2	3	12	54.
13	20	Longniddry	»	4.44	6	7	8	71.
17	60	Drem	»	4.48	4	4	40	67.5
29	20	Dunbar.	»	4.57 1/2	9 1/2	11	40	72.6
41	20	Grantshouse	»	5.10 1/2	13	12	0	55.3
46	20	Reston	»	5.15	4 1/2	5	0	66.7
56	40	Marshall Meadows.	»	5.23 1/2	8 1/2	10	20	72.3
57	42	Berwick	»	5.25	1 1/2	1	2	41.
72	70	Belford.	»	5.38 1/2	13 1/2	15	28	68.2
89	53	Alnmouth.	»	5.53	14 1/2	16	63	69.4
107	72	Morpeth	»	6. 9	16	18	19	68.5
124	42	Newcastle.	»	6.30	21	16	50	47.5
			dep.	6.33				
138	45	Durham	pass.	6.51 1/2	18 1/2	14	3	45.5
147	60	Ferryhill	»	7. 1 1/2	10	9	15	55.1
160	48	Darlington	»	7.13	11 1/2	12	68	67.1
174	62	Northallerton	»	7.26	13	14	14	65.5
182	42	Thirsk	»	7.33	7	7	60	66.4
204	58	York.	»	7.53	20	22	16	66.6
218	44	Selby	»	8.07	14	13	66	59.3
232	53	Shaftholme	»	8.18 1/2	11 1/2	14	9	73.7
236	72	Doncaster.	»	8.22 1/2	4	4	19	63.6
254	19 3/4	Retford.	»	8.36 1/2	14	17	27 3/4	74.3
272	60 3/4	Newark.	»	8.51 1/2	15	18	41	74.1
287	32 1/2	Grantham.	»	9. 3 1/2	12	14	51 3/4	73.3
316	40	Peterboro'.	»	9.27	23 1/2	29	7 1/2	74.4
333	79 1/4	Huntingdon	»	9.42	15	17	39 1/4	70.
360	75 1/4	Hitchin.	»	10. 3	21	26	76	77.
375	14 1/2	Hatfield	»	10.14	11	14	19 1/4	76.25
392	69	King's Cross.	arr.	10.30	16	17	54 1/2	66.3

Edinburgh-Newcastle : 124 miles 52 chns. in 2 hours. Average speed = *62.4 m.p.h.*
Newcastle-King's Cross : 268 miles 34 chns. in 3 h. 57 m. Average speed = *68.0 m.p.h.*
Edinburgh-King's Cross : 392 miles 75 chns. in 6 hours. Average speed = *65.5 m.p.h.*



Pacific type A4 locomotives, built at Doncaster, 1936.

Leading dimensions and ratios.

Grate:

Length on slope	5' 10 11/16"
Width	6' 11 3/4"
Grate area	41.25 sq. ft.

Firebox:

Height of crown above foundation ring front	6' 8 13/16"
Height of crown above foundation ring back	6' 0 5/16"
Interior length at top	8' 11 3/4"
Interior width at boiler centre	5' 4 1/2"
Thickness of copper plates sides and back	9/16"
Thickness of copper plates tubeplate	1 1/4"

Boiler:

Outside length of firebox, overall	10' 5 3/4"
Outside length of firebox at bottom	6' 8"
Outside width of firebox at bottom	7' 9"
Maximum diam. of barrel	6' 5"
Length of barrel	17' 11 3/4"
Thickness of barrel plates	7/8" & 13/16"
Thickness of wrapper plates	9/16"

Tubes, small:

Material	Steel.
Number	121
Diameter outside	2 1/4"
Thickness	10 I. W. G.

Tubes, superheater flues:

Number	43

Heating surface:

Firebox	231.2 sq. ft.
Tubes	1 281.4 —
Flues	1 063.7 —
Total evaporative	2 576.3 —

Superheater:

Number of elements	43
Diameter inside	1.244"
Heating surface	748.95 sq. ft.
Total heating surface	3 325.2 sq. ft.

Two Ross pop safety valves	3 1/2" diam.
Working pressure	250 lb. p. sq. in.

Axles:

	Dia.	Len.
Journals, pony	6 1/2"	× 9"
— coupled	9 1/2"	× 11"
— trailing	6"	× 11"

Crank pins:

Outside	5" × 6"
Inside	8 1/4" × 6"

Coupling pins:

Springs. — Bogie : Helical, 10 1/2" long free, 5 1/16" outs diam., Timmis section. — Coupled wheels : Laminated 16 plates 5" wide × 1/2" thick. 4' 0" crs. — Trailing : Laminated, 11 plates, 5" wide, 5/8" thick. 4' 6" crs.

Brakes . . . . . Vacuum.

Cylinders:

Number	3
Diameter	18 1/2"
Stroke	26"

Motion:

Type : Outside	Walschaerts.
— Inside	Gresley.
— Valves	Piston.
Diam. of valves	9"
Max. travel of valves	5 3/4"
Steam lap, outs. cylinders	1 5/8"
Steam lap, ins. cylinders	1 11/16"
Exhaust lap	Nil.
Cut-off in full gear	65 %

Tractive effort at 85 % boiler pressure . . . . . 35 455 lb.

Total adhesive weight . . . . . 147 840 lb.

arubber under the carpet and hair between the floorboards, the whole ne underside of each vehicle has been lated by means of sprayed asbestos ported on dovetailed steel sheeting. sound proofing has been further enced by the interior finish employed, whole of the inner walls and ceilbeing covered in Rexine. The wins are formed of double glass with insulating space between. To exe noise at the articulated ends the gways are lined with felt.

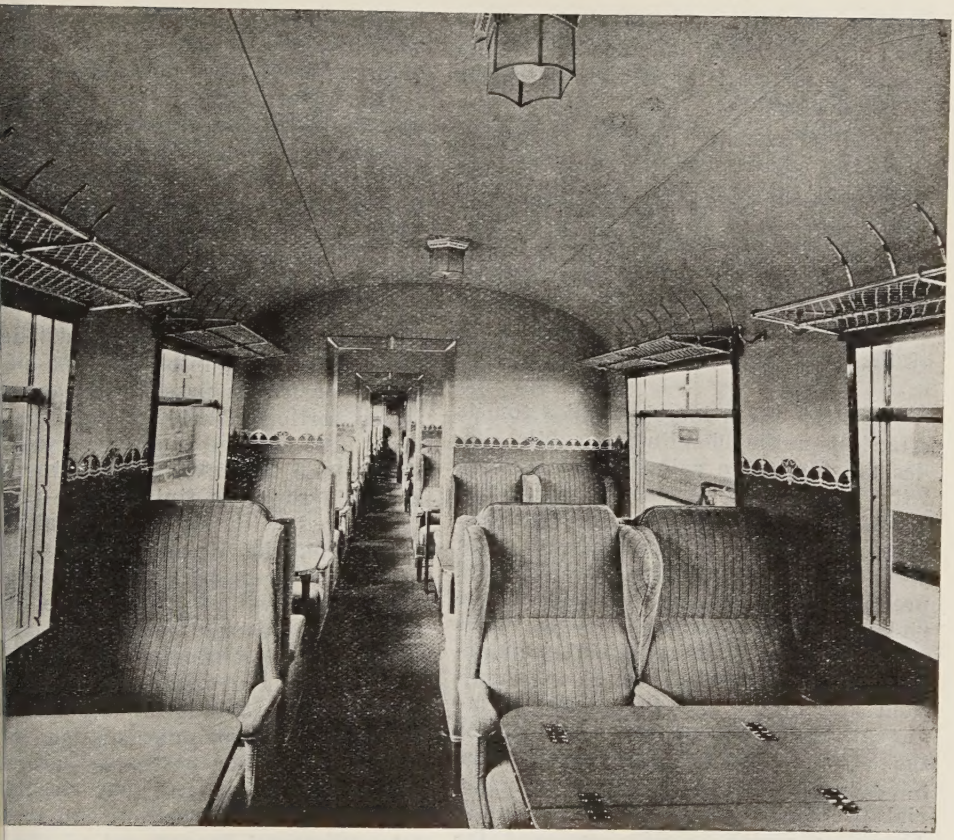
ne bodies are mounted on steel unrames which have been fabricated neans of electric welding and comble riding has been ensured by the ision of compound bolster bogies. Pressure fed grease lubrication has been provided at all articulated couplers, bogie pivots and friction blocks. Pullman vestibules and buckeye couplers are fitted in accordance with the usual L.N.E.R. practice. The indiarubber fairing between the bodies was supplied by Messrs. G. Spencer Moulton and is fitted with a small initial tension and secured permanently by screws to the twin ends of the carriages. At the outer ends of the vehicles the indiarubber is held on a series of studs and secured by a steel band extending over the roof. An arrangement of clips enables the band to be released and the indiarubber detached very quickly when the carriages are separated to enable the tail vehicle to

be reversed at the end of the journey and for periodical examination of the automatic couplers.

The whole of the seats on the train can be reserved and every effort has been made to provide the maximum possible comfort for the individual passenger. The arrangement of the interior of the train is quite new and provides the privacy usually associated with compartment carriages, whilst retaining the advantages and spaciousness of open vehicles. The first-class saloons have been divided into sections by means of partitions, each section seating four passengers, two on either side of a central gangway, but no doors are provided except at the ends of the vehicles and between « smoking » and « non-smoking » se tions. The provision of ornement screens projecting from the partitio gives an alcove effect.

It will be seen from the layout of t train that no separate restaurant-c accomodation is provided and each p senger can, therefore, take his meals the seat which is allotted for the jo ney.

The arrangement of the first-class bles and seating is novel as far this co try is concerned. Fixed tables are p vided and the chairs are arranged swivel, enabling the passenger to sit n mally at the table at meal times and turn away from the table when so de ed. The tables are specially shaped



the swivelling chairs and the tops covered with glass under which tap- is placed to tone with the general ne.

e decoration of the coaches reflects rked advance on conventional prac- though the design belongs to no pe- or style in art. It is quite original has been designed for the L.N.E.R. pany by Mr. Murray Adams Acton, essrs. Acton Surgey Ltd., 3, Bruton t, London, W. The decorators have avoured to make the interior of each harmonious and refined in a dif- t manner, and whilst each scheme upon simplicity and restraint and nbination of complementary colours ts effect, no attempt has been made to disguise the main structural lines of the coaches, but rather to add emphasis to them. The decoration applied to the walls extends to less than half their height in order to express the maximum amount of space in the area available. Ornament has been used with great care and moderation. It is small in scale so as not to obtrude too aggressively upon the scheme as a whole.

The decorative effect has largely been obtained by developing the design and colours of certain modern materials which have not been used previously in similar combinations.

The originality of the schemes precluded the use of more or less standardised designs of fittings. These small

fittings, such as racks and lights, have been specially manufactured and designed in materials to suit the character of the decoration.

The freshness and pleasant atmosphere of the colour schemes, and the restfulness of the seating and planning, in conjunction with the installation of a modern form of air-conditioning, provides a remarkable advance and improvement in travel comfort.

The details of the decoration in each of the first-class saloons are given below.

The first coach largely replies for its effect upon the blending of subtle shades of atmosperic colours, and is lined with Rexine, the surface of which has a texture giving a fine stippled effect in a green colour. The tones of green selected were specially matched and prepared in the Rexine by Messrs. Imperial Chemical Industries Ltd. The walls are decorated by the application of panels and ornemental features in Alumilited aluminium and the panels frame an entirely new form of treatment for the Rexine developed by Messrs. Acton Surgey Ltd. by the introduction of a special process of embroidery. A plain Alumilited finish is also employed for the aluminium architraves at the doorways and for the decoration of the screens on each side of each doorway opening. The chairs are upholstered in green uncut moquette, each chair being finished in scarlet braid. The carpet is of green employing a small trellis pattern picked out in scarlet. Each window is framed in black ebonised woodwork and is provided with curtains of silk brocade suspended beneath the net rack. The rack is of aluminium, designed to harmonise with the rest of the compartment and incorporates a light fitting at each end to give an individual light to each passenger. A further lamp in an Alumilited aluminium fitting is provided in the centre of each section.

In the other coach, there is a very u
usual scheme of decoration consisti
of ornemental silver nails with decor
ed heads forming a frieze, used in co
junction with the aluminium mouldi
The doors are likewise heavily studd
with these decorated silver nails. T
Rexine in the lower portion of this v
hicle is of a very dark green shad
whilst the upper portion of the wa
and the ceiling are covered in crea
Rexine.

The third class saloons are divided
cross partitions into sections of si
twelve or fifteen passengers each. T
upper portion of the walls and the ce
ings are covered in stone colour
Rexine and the lower portion in Rexi
having a shagreen finish. The junctio
is covered with an ornemental alum
nium fret, the Rexine under portio
of the fret being picked out in crimso
The doors which are of the dark
Rexine are outlined in crimson and d
corated in aluminium. The upholste
is of fawn uncut moquette whilst gre
carpets are provided mounted as in t
first-class saloons on sponge rubb
1/2″ thick. Four passengers are sea
at one side of the gangway and two
the other in each section, and to fac
tate movement in and out of the la
seats the double tables are provid
with hinged side flaps.

Lighting fittings similar to those
the first-class compartments are prov
ed, one lamp being fitted in each p
senger section.

In order to facilitate the service
meals to all seats in the main port
of the train, two kitchens have been p
vided each equipped with electric co
ing apparatus of the most modern t
specially designed for this service
Messrs. J. Stone & Co., and supplied
Messrs. Henry Wilson & Co., of Li
pool. The equipment in both kitch
is identical and consists of the m
cooking range, comprising roasting
steaming ovens, two grills and a boi
table having four hot plates. A sepa

h fryer is also provided and a vege-
ble boiler is arranged near the elec-
cally heated sinks on the body side.
automatic water boiler including cof-
e and milk urn, manufactured by
essrs W. M. Still & Co., is arranged
ongside the hot cupboard on the corri-
r partition and an automatic refrige-
tor, having separate compartments
r iced wines, butter, cheese and ge-
ral provisions, is also fitted.

The necessary power is obtained from
o 10-kw. axle-driven generators sus-
nded under each kitchen car in ac-
rdance with the L.N.E. standard prac-
e, and supplies power at 180-220 volts.
Exide-Ironclad double battery of
0 ampere-hours capacity is provided
each car for use when the train is
nding.

The usual pantry accommodation is
ovided and in this connection it
ould be noted that the table linen,
ass, crockery and silver is of distinc-
e design in keeping with the special
aracter of the train.

A particular feature of the whole train
the wide corridors and ample cir-
lating space at the ends of the carria-
, permitting easy circulation of pas-
gers joining and leaving, and recog-
ing that passengers travelling on
se trains will take more luggage than
t required for shorter journeys, lug-
ge racks have been provided in the
acious entrance vestibules and addi-
nal accommodation has also been pro-
led in the tail car.

The first-class lavatories are decorat-
in stippled green Rexine, coloured
shbowls and hoppers being provided
match. The fittings are chromium
ted and a full-length mirror is also
ed. The hot water apparatus is heat-
by means of steam in the winter
e, whilst in the summer, heat is ob-
ned from an immerser heater sup-
ed from the train lighting dynamos.
floor is covered with Korkoid to
tch the walls.

The third-class lavatories are fitted in a similar manner, except that the prevailing tone is yellow.

The train is fitted throughout with a system of ventilation and heating supplied by Messrs. J. Stone & Co., by means of which filtered air, heated to a comfortable temperature and thermostatically controlled, is introduced into the carriages at floor level and extracted through grilles in the lighting fittings in the roof. Ducts leading to large extractor ventilators enable the air in each vehicle to be completely changed every three minutes. Direct ventilation is also obtained by means of a sliding shutter ventilator above each side window.

One of the most interesting innovations of the train is the provision of a fully streamlined end and advantage has been taken of this feature to provide an observation saloon fitted with a settee and comfortable armchairs, from which passengers who so desire may for a time obtain a view from the rear as the train proceeds.

The sides and ceiling of this saloon conform to the streamline shape of the exterior, large windows being provided at each side. Particular attention has been given to the design of the windows in the streamlined end of the car, which are moulded to the curve of the end over the full width of the vehicle and are made of the special type of glass substitute known as « Perspex », supplied by the Imperial Chemical Industries, which is unbreakable and is now being used extensively for the windows of aeroplanes.

The guard's compartments at both ends of the train are fitted with electric food heaters and the necessary switches for the control of the electric lights throughout the train. Screens are provided in the luggage compartments to ensure an unobstructed passage down the van for passengers wishing to visit the observation car.

NEW BOOKS AND PUBLICATIONS.

The Universal Directory of Railway Officials and Railway Year Book. 43rd Annual Edition 1937-1938. — London, The Directory Publishing Co. Ltd., 33, Tothill Street, Westminster, S. W. 1; 588 pages (8 1/2 in. × 5 1/2 in.). Price : 20 sh. net.

The new edition for 1937-38 of the Universal Directory of Railway Officials and Railway Year Book is now ready. The lists of railway officers and statistical information have been revised and proofs submitted to and checked by the Railway Administrations throughout the world.

This Directory is of great value to Railway Administrations in connection with correspondence, and to Engineers and Manufacturers doing business with Railways.

The general arrangement of the book is on a geographical basis, and the order in which they appear has been selected so as to group all the railways in the United Kingdom, the British Colonial Empire and the Dominions in sequence, followed by the railways of foreign countries in which important British interests are held, and lastly, the railways of other foreign countries. On this principle the general arrangement is as follows :

Great Britain.
Northern Ireland and Irish Free State
British Colonial Empire.
India.
Australia.
New Zealand.
Canada and Newfoudland.
Africa.
Argentina.
Brazil.
South America(other than Brazil and Argentina).
Europe.
Asia.
United States of America.
Central America.

Then follows other general railway information. For ready reference purposes, at the end of the volume will be found three indexes : (1) an index of countries, (2) a general index covering all railways and official entries together with the statistical and other information section, (3) a personal index of railway officials.

ERRATUM.

BULLETIN, MAY 1937.

Report by Messrs. DUMAS and LEVY on Question IV (Paris Congress, 1937).

Page 1466/224 (Table)

Instead of :

2 Corpet-Louvet railcars with two 250-H.P. Frichs diesel engines (State).

Elec.	Jeumont.	120 (75)	8	54 (*53.1*)	Rev. Trailer.	65	...	...

Read :

2 Corpet-Louvet railcars, with two 250-H.P. diesel engines (Frichs licence) (State).

Elec.	Hillairet, Titan licence, Copenhagen.	120 (75)	8	54 (*53.1*)	Rev. Trailer.	65	...	...